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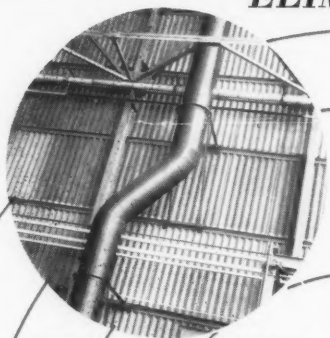

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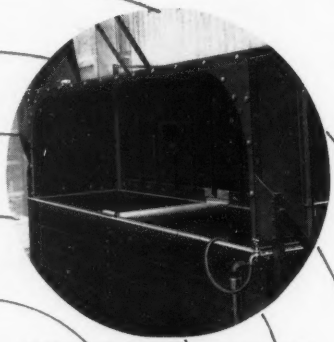

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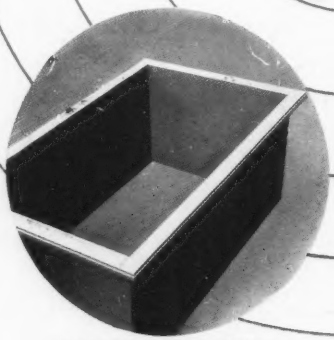

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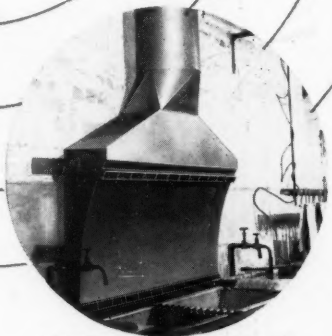

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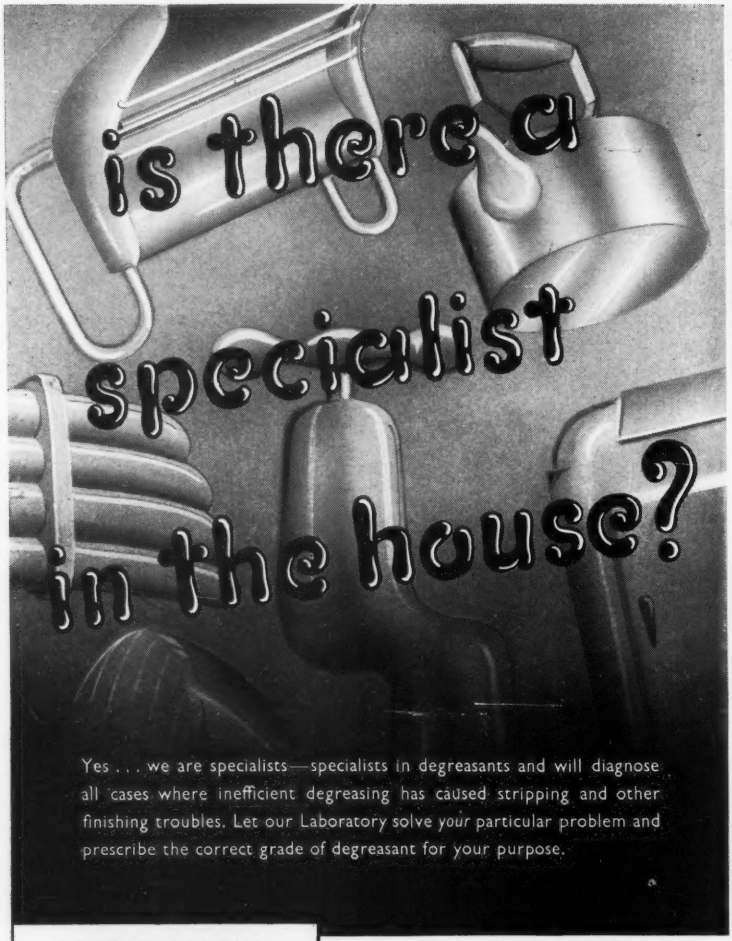

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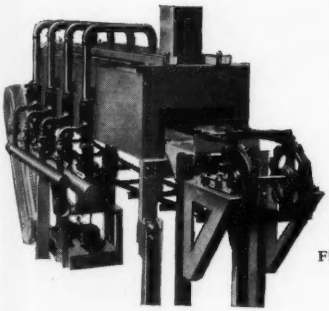

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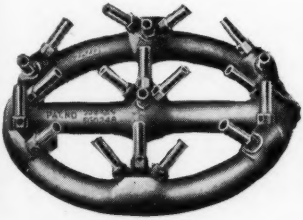

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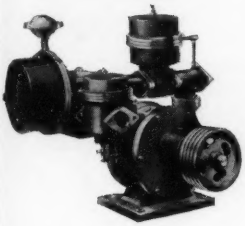

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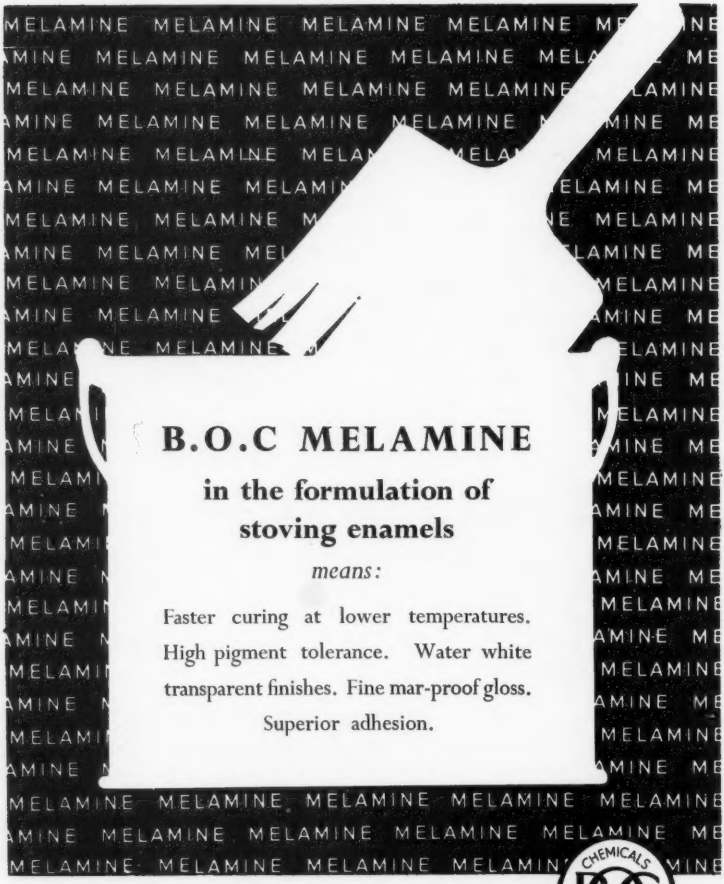
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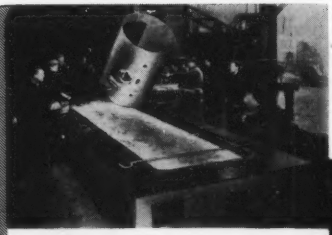

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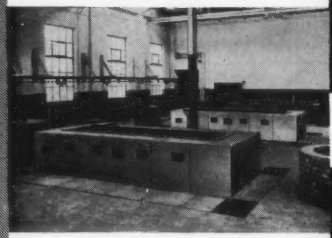

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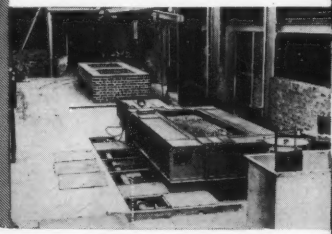

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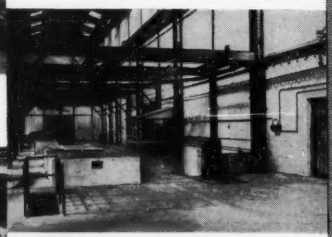

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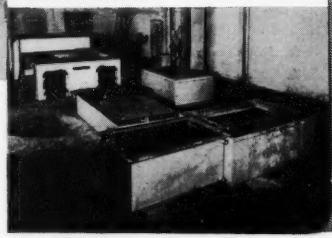

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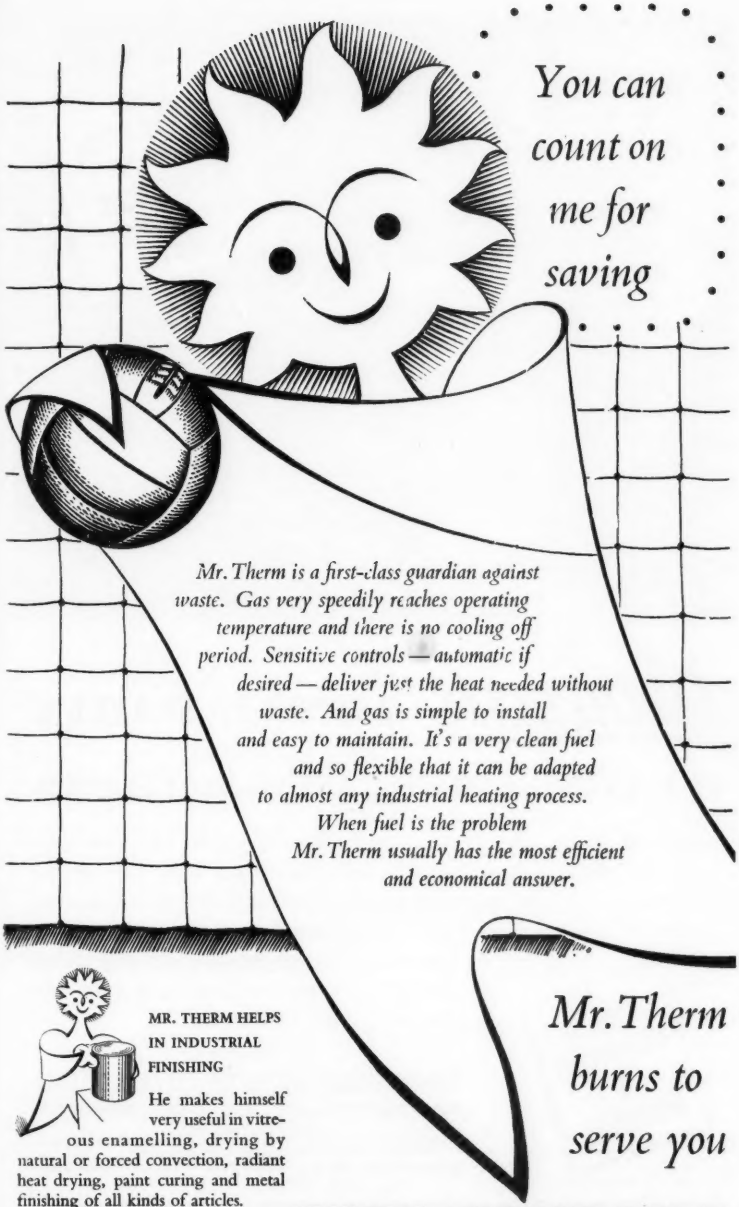
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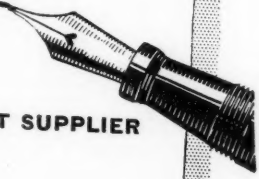

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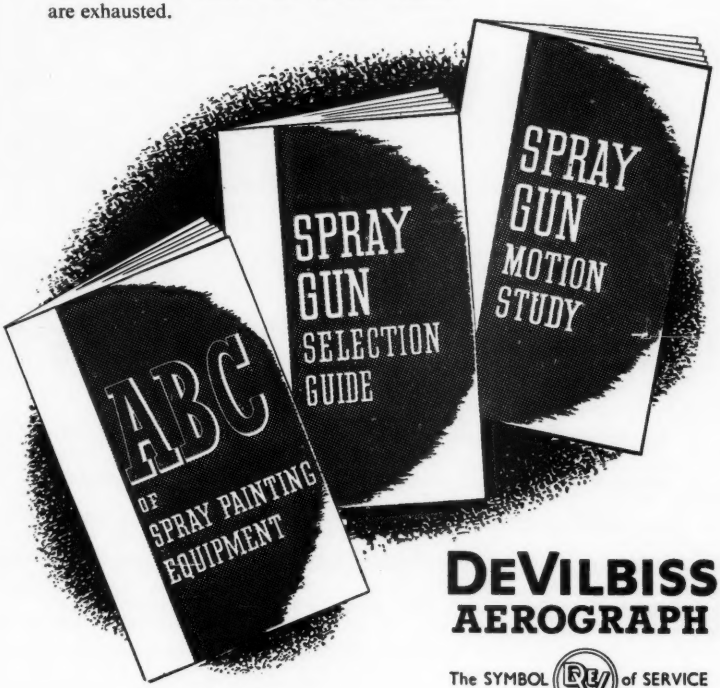

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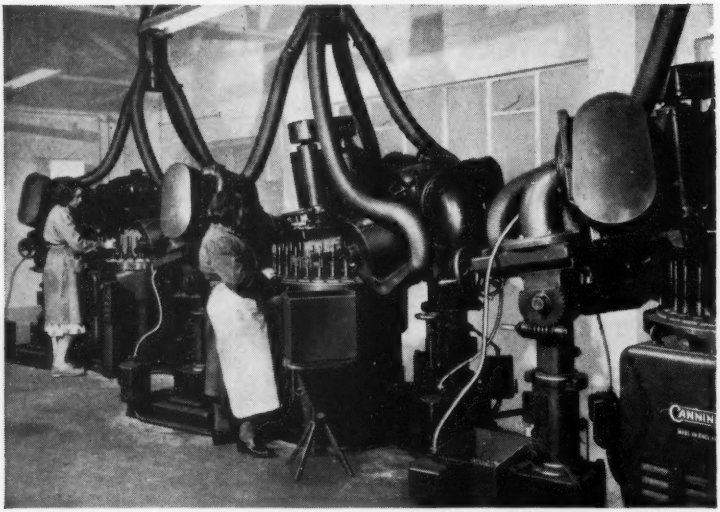

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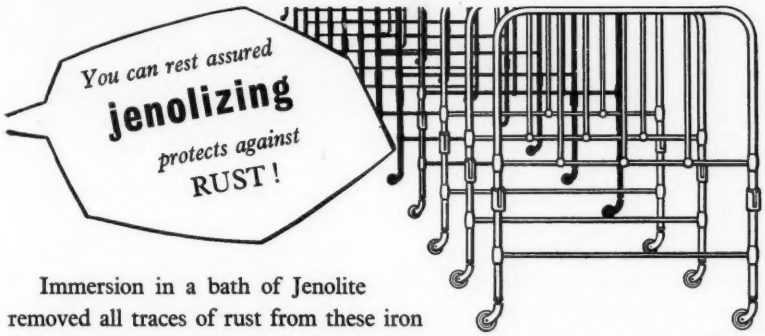

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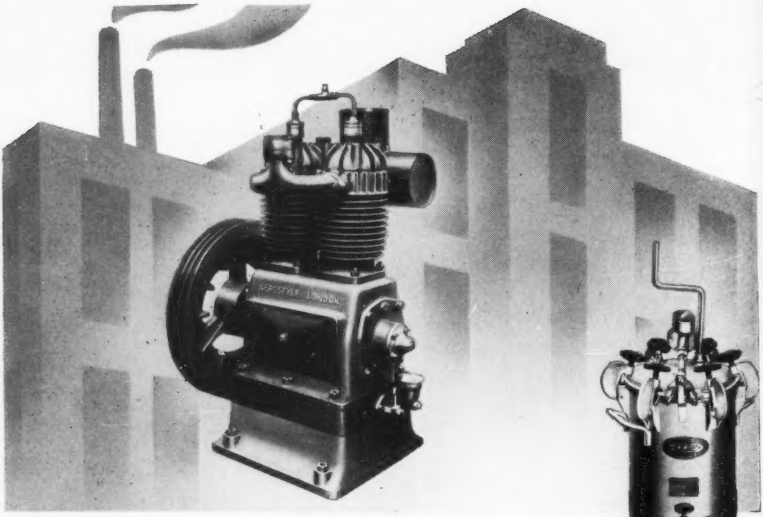

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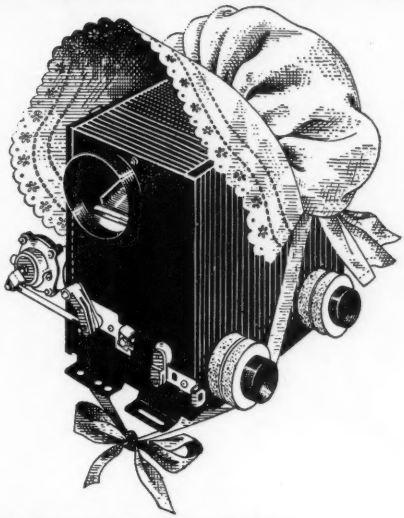

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DECEMBER 1953

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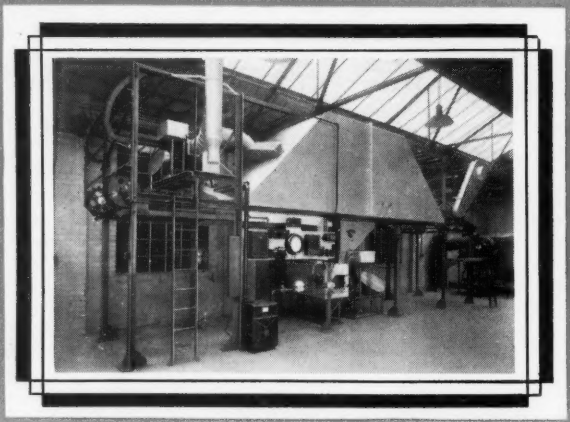

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VOL. 6 DECEMBER, 1953 NO. 66

Inspection Standards

OF all the services an employer "buys" to operate his business, the most important —and probably the most uncertain—is inspection. This single item can make the difference between profit and loss or between favourable and unfavourable customer reaction.

The paint shop is particularly vulnerable in this respect and the standard of inspection used in most establishments is largely a traditional one. It is based on individual visual examination and is very difficult to define. By the use of testing procedures and careful checks on incoming material it is possible to ensure that the material and workmanship of constructional processes are of a satisfactory standard. In the case of the finish, however, it is a very different matter. One of the troubles is that the standard varies according to the temperament of the inspector and a standard that would be acceptable one day may well be too low on another day when the inspector feels more zealous. In the case of assembly operations, manufacturing and fitting work, it is possible to say quite definitely whether a job is right or wrong and, if necessary, to refer to a known and accepted standard. In the absence of such a standard, however, there is always the tendency to argument between inspection and production.

In the paint industry in particular, there has always been a good deal of reliance on what can best be described as "rule-of-thumb" inspection methods. We do not say this in any disparaging way, frequently the rule-of-thumb inspector achieves a regular and consistent high standard due to the fact that his method is a kind of industrial instinct which he has developed over a long period and to a very high degree. Most people today, however, feel that rule-of-thumb methods are out of date and inefficient and not in accord with modern methods, they seek something more definite; the setting up of a system which would give definite standards of finish. It is difficult, however, to see what can be done.

One development we recently heard of uses a series of parts and panels finished deliberately to a standard regarded as the minimum acceptable, and reference is made to these to see if a questioned finish is up to standard or not. Another system is the adoption of a range of decreasing standards for different parts of a product. For example, in the case of a machine tool the principal visible surfaces are checked against a first-class standard, the surfaces on which fittings or parts are mounted and which do not call for quite such a high finish are checked to a second-class standard and the baseplates, insides of gearboxes and backs of panels or inside edges of frames are allowed a still lower, third-class finish. It is claimed by the firm that instituted the system that an immediate saving of up to 40 per cent of the finishing time was made.

The problem of specifying standards of finish is a large one and there is no easy answer. In arriving at our standard we must bear in mind what the product is and what it must stand up to. Then we must consider which characteristics are of most importance in the finish. Finally, we must define a method of measuring and comparing those characteristics. This last requirement is the most difficult. We offer no prizes for the answer but we would like to hear from readers who have ideas on the subject.

Progress with Fluorescent Materials

by A. E. WILLIAMS, Ph.D., F.C.S.

WHILST fluorescent phenomena have been well known for many years, the scientific use of fluorescence for publicity purposes is of comparatively recent date, and has resulted from a systematic study of the physical condition determining maximum brightness. In the case of the material rhodamine, for example, if we make a strong solution of 5 per cent. or 10 per cent. strength, it appears as a rich red colour without any signs of fluorescence. If, however, we pour away the concentrated solution and wash out the container with water, the dilute wash water exhibits strong fluorescence. The latter depends, therefore, to a great extent upon dilution; though on over-dilution the brightness diminishes. To obtain a strong fluorescence the colour must be in solution.

For commercial application, the colour, as such, if added to varnish or other vehicle and applied to a surface, will give when dry merely a colour; the fluorescent properties of which are practically nil. If the same colour be dissolved, however, and then dried out in admixture with a synthetic resin, which is then polymerised and ground into very fine particles, these particles on dispersion in another medium will produce the same colour, but greatly intensified by the added brightness of fluorescent light caused by absorption of ultra-violet energy.

It follows, then, that a fluorescent colour is made by dispersing in a suitable varnish or other medium fine particles of a fluorescent substance in the form of what may be regarded as a solid solution. A feature of most fluorescent substances is that they are activated far more intensely by ultra-violet light than by visible light. The visible colours occupy only a very small part of the whole spectrum, consisting of rays having wave-lengths of about 4,000 to 7,500 Angström units. As the wave-lengths get shorter they extend through the near ultra-violet, the extreme ultra-violet, the X-rays, radio-active rays, and right on into cosmic rays. At the other end of the spectrum, as the wave-lengths become longer we enter the infra-red region.

The amount of fluorescence arising from a particular substance is governed largely by the wave-lengths in contact with it; so that the matter of wave-length is of great importance in connection with fluorescent substances. While a colour such as rhodamine, which is a brilliant red by reflected light, when applied to a piece of wood or paper, will absorb light of its complementary colour green, and the energy so absorbed will be converted into orange light by fluorescence; the intensity of the fluorescence will be immensely greater if the colour be illuminated by ultra-violet light, which it also absorbs.

Investigations show that colours which are fluorescent in the visible spectrum are much more brilliant in the longer ultra-violet rays, and the visible effect on fluorescent substances is plainly produced by wave-lengths in the region of 3,600 to 3,900 Angström units. It is found that the fluorescent reflected light produced by this band, when measured photo-electrically, is many times greater than that produced by visible daylight.

This has been shown to be true by tests carried out on certain British-made pigments, wherein a patch of

one of the pigments is very luminescent when radiated with a wide range of ultra-violet from a suitable lamp. If, however, a filter is placed in front of the lamp, thus cutting off all but the ultra-violet present in daylight, the brilliance would be little affected; but if we then illuminate the patch with visible light from which all ultra-violet light has been eliminated by the use of a filter, the fluorescent light reflected would be relatively feeble. In practice, this feature makes the fluorescent colours of great value as poster colours, for these have exceptional brilliance at dusk when visible light is weak but the ultra-violet is still strong.

Zinc Sulphide

A well-established fluorescent material is prepared from zinc sulphide and mesothorium. For this purpose the zinc sulphide is obtained in a highly pure state by precipitating a solution of zinc chloride; the sulphide being then dried in an air oven at about 105° C., ground down to a fine particle size and finally sifted through a silk sieve.

Much difficulty has been experienced in grinding phosphorescent materials such as zinc sulphide without impairing the phosphorescent properties, but a recent process of the Eastman Kodak Co. (B.P. 591,121) describes a suitable method. In this, the coarse zinc sulphide is ground in an organic solvent containing a fatty acid such as stearic acid. The liquid is decanted and the residue heated at about 70° C., which is approximately the melting point of the fatty acid, until the solvent is entirely evaporated. The stearic acid-coated powder is mixed with plasticised cellulose nitrate for certain applications.

When mesothorium is used in conjunction with the sulphide, a filling material is employed and this may be copper in the form of a dilute copper sulphate solution, one part of dried zinc sulphide being added to 10,000 parts of the sulphate solution. The solid material is recovered from the solution and dried, ground, and heated in a furnace to about 1,350° C. When sufficiently cool, an equal weight of mesothorium is added and the mixture immersed in dilute ethyl alcohol of about 5 per cent. strength. The whole is next poured on to a filter which retains the solids, the latter being washed several times on the filter with the same strength of alcohol.

After thorough washing, the solids are dried under vacuum at a temperature of 70° C., until the moisture content is not more than 1 per cent. to 2 per cent. The product so obtained is a luminous powder, its maximum luminosity being attained about three weeks after manufacture. It is commonly used in a copal varnish or cellulose nitrate medium.

Resinous Products

The most recent of the commercially-applied fluorescent materials make use of synthetic resins as a carrier. In the U.S.A. processes have been developed wherein the fluorescent substance is mixed with an unpolymerised synthetic resin dissolved in a solvent, the resin upon polymerisation producing a hard glossy surface. The main process used is that of J. L. and R. C. Switzer (U.S.P. 2,498,592) in which the resins employed are urea and melamine-formaldehyde, and methacrylate types. Preference is given to thermoplastic resins, since the thermo-setting grades tend to create lumpy material during grinding.

The really strong fluorescent colours belong to a few restricted classes, such as rhodamine, in the xanthene group; euchrysin 2G, in the acridine group and safranin, in the azine group, although a few other materials are in use. According to the Switzer process, a typical mix for a luminous preparation is as follows. Fifty grams of butyl alcohol-modified urea-formaldehyde resin in 50 per cent. solution is mixed with 0·2 gram of the colour 4-amino-1:8-naphthol-p-xenylimide.

After thoroughly mixing the colour in the resin solution, the mixture is heated to a temperature of 90° C. to eliminate some of the liquid portion. Heating is continued until the material assumes a gel-like form and this "jelly" is cured by heating to 140° C. when it gradually produces a hard glass-like product. This is then ground and sifted through a 200-mesh sieve; the sifted powder forming the luminous raw material for addition to a vehicle such as copal varnish. As is the case with zinc sulphide preparations, this organic colour cannot be ground to a

very fine particle size without loss of luminosity.

It is possible to use mixtures of colours and these may be mixed in with the resin by absorption from solution, and it is possible to employ colours of fairly high molecular weight in stronger concentrations than is possible with low molecular weight substances, without loss of fluorescent properties. In general, with yellow colours the concentration may be as high as 0·025 gram per cubic centimetre, but with red colours the concentration does not generally exceed 0·015 gram per cubic centimetre.

In considering the use of the fluorescent materials, irrespective of whether they are to be employed in poster work, indicators, signs, signalling, etc., three chief factors have to be dealt with: permanence, that is, minimum fading; visual brilliance; and non-interference between pigment and suspending medium. In the pigments themselves it has been found that for dispersions of the colours in resins, 15 mg. of colour per c.c. is required in the case of the red colours, and up to 25 mg. per c.c. for colours of less refrangibility.

In British practice the cured resins containing the colours are ground to a particle size of only a few microns, generally between 20 and 50 microns, and these are in turn dispersed in a water-white ultra-violet transparent varnish; the refractive index of which is as near as possible to that of the resin pigment.

Figs. 1 and 2 depict part of the plant used by a British company in the preparation of fluorescent materials, showing respectively, a large motor-stirred, thermostatically-controlled vessel for melting the synthetic resins and blending the colours; and the infra-red apparatus wherein the coloured resin particles are carried on an endless belt beneath a series of infra-red elements.

When correctly applied, the British products will re-emit as much as 120 per cent. of the visible light falling upon them; whereas the brightest organic pigments will reflect only about 60 per cent. The extra brilliance is, of course, due to the sum of the light produced by fluorescence and that reflected from the visible spectrum in the ordinary way. There is some fluorescence caused in the case of rhodamine colours from the green wave-lengths absorbed, but there is sometimes confusion of thought as to the relative importance of the absorption of rhodamine in the visible and the near ultra-violet.

During the preparation of the fluorescent materials, the Switzer brothers of America discovered that if the colour was first enclosed in or "clothed" with the resin—the *p*H of which has to be carefully controlled—and after grinding the particles were re-dispersed in another medium, fading was very much diminished. With the British products, in the light of a well-illuminated building the full fluorescence has been maintained for several years; but outdoors the life is very much curtailed and does not normally extend over more than a few months.

To obtain the greatest brightness, the particles are distributed so that the final film of fluorescent material going on to paper, wood, etc., for display purposes is about 3 mil. thick. In this thickness or depth of film, something between 0·000015 and 0·00003 grm. of pigment is distributed per square centimetre of surface area. When applied to paper, as in poster work, the physical conditions so provided enable light to penetrate right through the layer to its white background, and by internal reflection on to the pigment particles.

With the scattering effect produced, the whole 3 mil. layer becomes "alive" and produces the extraordinary brilliance to which one is now being accustomed in modern poster advertisements and other displays. Where large surfaces have to be covered with the fluorescent material, waterproof paints have recently been introduced to protect the fluorescent surface from mechanical abrasion or excessive rain. This treatment reduces the amount of fluorescence available, but the life of the fluorescent substance is prolonged. Both the fluorescent layer and the waterproof paint may be applied in the usual manner by brush or spray gun.

Treatment of Fabrics

The treatment of fabrics with fluorescent colours, both by the deposition of the colour within the fibres of the

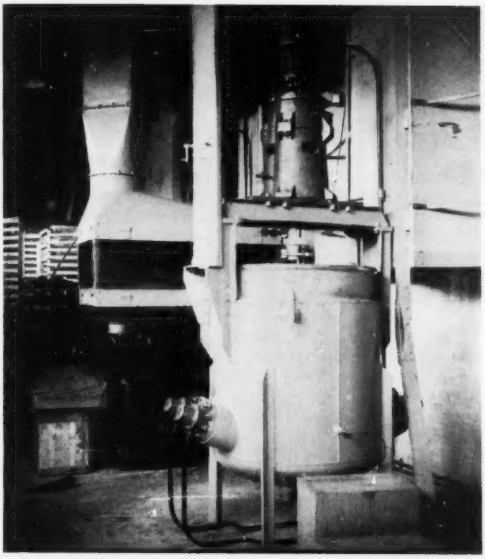


Fig. 1. Large motor-stirred, thermostatically controlled vessel for melting the resins and blending the colours in the preparation of fluorescent materials

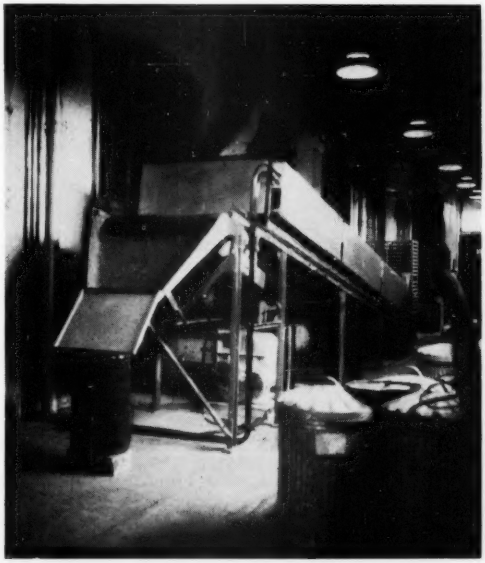


Fig. 2. Infra-red curing apparatus, wherein the coloured resin particles are carried on a belt beneath a series of infra-red elements

woven material, and the solution of the colour in the material from which the fibres are spun, is being increasingly applied. Much of the original work in this sphere has been carried out in the U.S.A. by the Switzer company which has produced fabrics of great brilliance. For the treatment of the fibres of rayon or cellulose acetate material, the fluorescent colour can be either dissolved in or deposited within the material; this process being analogous to the technique of fluorescent paint making wherein the fluorescent material is dissolved in a synthetic resin and afterwards polymerised.

A feature of the Switzer processes is that some of them involve dissolving the fluorescent colour in a solvent which has a swelling action upon the fibres or filaments. As an example, 6 oz. of white cellulose acetate fabric is coloured by immersion for 2 min. in an aqueous bath of 50 per cent. strength ethyl alcohol, containing 0·3 per cent. of a colourless fluorescent substance. This is given a cold rinse and then dyed in the usual manner, and the result is a fabric which has a brilliant fluorescence. In colouring fabric in this way, the amount of colour dispersed must not exceed 0·0005 grm. per square centimetre of fabric surface.

Fluorescent fabrics of various colours were used by the American forces in World War II. A signal laid on the ground can be observed by an aeroplane flying at an altitude greater by three to four times than is the case with that of a similar but purely subtractive colour. To test the visibility of fluorescent fabrics when carried by aircraft, a U.S.A. helicopter carrying in a prominent position a piece of fluorescent fabric, ascended to a great height and then descended at a slow speed; the fluorescent fabric became visible from the ground 4½ min. before any other part of the helicopter was seen. Considerable use was made in the recent Korean war of fluorescent signs and signals.

Testing

The relatively few colours which exhibit notable fluorescence require to be used in a highly pure form; the purity having an important influence on the brightness. In dealing with a colour such as xylene red, for example, one may obtain one delivery of a so-called 200 per cent. strength, and later on a delivery of a 400 per cent. strength material. Although by using twice as much of the 200 per cent. product it is possible to obtain the same colour concentration, the fluorescence output may be very much lower.

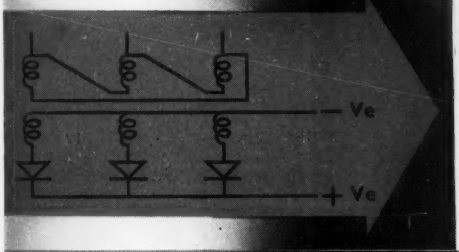
It is known that some of the molecules of a system emitting fluorescence contain a much higher electronic energy than that corresponding to the actual temperature of the system, and that excited molecules can lose their excessive energy by collisions with other molecules, by so-called quenching. Investigations in British laboratories have indicated that a colour diluted with an electrolyte such as sodium chloride may have a quenching effect, especially as the resin in which it is dissolved is a conducting medium.

Specimens of fluorescent colours are tested in many cases by making a silk screen sample having the specific coating thickness of 3 mil. A piece of uniform size of the sample is placed in a holder at an angle of 45° to a beam of ultra-violet light from a Mercra lamp, which is a high-pressure mercury vapour lamp filtered with an outer bulb of Wood's glass. Interposed is a Chance filter which cuts off all but the band of ultra-violet light. The fluoresced light is deflected on to a barrier layer photo-cell and the current measured with a microammeter. This result may then be compared with the fluorescence produced by illuminating the specimen with selected bands of the visible spectrum from a monochromating device.

For the purpose of testing fluorescent colours it is possible to make a very simple ultra-violet spectrograph which has an accuracy to within a few Angström units. This consists of a simple slit—two safety razor blades, for example— and a small fluorite or quartz collimating lens, behind which is a diffraction grating replica mounted on a flat quartz plate. The ultra-violet spectrum from the grating is focused by a second lens on to a back taking a plate-holder, and it is quite simple by photography to make a wave-length scale in contiguity with the spectrum.

In the preparation of fluorescent colours, the type of medium employed

RECTIFIERS FOR ELECTROPLATING



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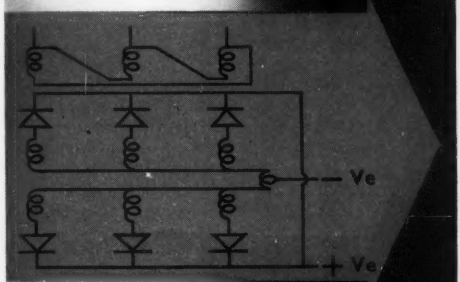

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is of great importance. It is quite easy to destroy the fluorescence by using the wrong medium. The medium with which the fluorescent particles are milled has to have not only the highest possible ultra-violet transmission, but also as nearly as possible the same refractive index as that of the animo resins with which it is made. There has to be a correlation between the refractive indices and the absolute maximum of transparency to ultra-violet light.

The medium must also be of a character which does not yellow on exposure to daylight, as otherwise it would immediately start filtering out the ultra-violet rays. Since fluorescent colours are high-quality products, they are easily contaminated by using dirty tools or containers. Experience shows that when the colour is applied correctly to a suitable surface, and not over reduced when it is put on, it will not be washed out by rain. If, when it is applied, it is over reduced, it is very much inclined to powder. The use of a protective varnish over the fluorescent colours lessens the tendency to collect dirt on the surface and also enables the latter to be washed down.

REASONS AND METHODS FOR TIMBER PRESERVATION

A PARTICULARLY interesting paper with the above title was presented last month at the Society of the Chemical Industry's meeting by E. H. Nevard, Esq., B.Sc., of the British Wood Preserving Association. The paper dealt with the fungal attack on converted timber and outlined the minimum requirements of satisfactory preservation methods.

In the course of his paper Mr. Nevard pointed out that the many thousands of species of fungi fall into well-defined groups, each with its own biological and ecological characteristics. They are all propagated by the dispersal of air-borne spores. Certain fungi readily attack the sapwood of nearly all kinds of timber; the resistance to decay of the heartwood depends on the species of tree. Hardwoods are as susceptible as softwoods and some species, notably beech, birch and sycamore, tend to deteriorate very rapidly, both heartwood and sapwood.

In temperate countries damage by insect attack is caused in the main by Xestobium, the Death Watch Beetle, by Anobium, the Furniture Beetle, and by Lyctus, the Powder-Post Beetle. The larvæ bore into the wood, devouring the sapwood. Lyctus beetles demand a high starch content and attack freshly-felled timber. Anobium usually attacks timber which has been felled ten years or more. Xestobium prefers slightly decayed timber—usually old oak. Another species, Hylotropes Bajulus—the house longhorn—is now not uncommon in the south of England and usually selects pine sapwood.

Preservative treatment by brushing, spraying, or dipping, gives only surface protection, which will not be adequate except where the risk of decay is small, though there is usually no alternative when dealing with existing buildings from which the timbers cannot be removed for more efficient treatment. Surface treatment does not give the required protection against insect attack.

Soaking in a preservative gives greater penetration, and therefore greater protection, if the timber is permeable. The apparatus required is inexpensive and easily obtained, but, for relatively good treatment, the operation must extend over several days.

Pressure methods should give complete penetration of all sapwood and the maximum penetration into any heartwood. The operation is under complete control and eliminates wastage of the preservative. Expensive plant is necessary, but treatment can be carried out usually within a few hours and, at the most, within a day or so. Various treatment cycles are used, according to the species of timber and the sizes of the pieces, and the treatment is usually supervised by expert operators.

The hot and cold open tank method can be applied with reasonable results to permeable timber. The cost is very much less than that of pressure treatment, but there is far less control over the process and the treatment usually takes at least one day.

Preservatives in common use are of three types, the creosote type and the oil-solvent and water-solvent types,

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GRINDERS
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MACHINES
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the last two consisting of toxic chemicals in oil and water respectively. Each type has its own particular advantages and each is used for specific kinds of work.

There is a growing appreciation of the advantages of preservative treatment, both at home and abroad.

BRITISH COLOUR MAKERS' ASSOCIATION

MR. A. S. Callaghan (Imperial Chemical Industries Ltd.) is the new chairman of the British Colour Makers' Association. Mr. H. Gosling (Cornbrook Chemical Co. Ltd.) is vice-chairman. Hon. treasurer is Mr. C. G. A. Cowan (Cowan Bros. (Stratford) Ltd.).

The Council consists of Mr. C. M. Beavis (Golden Valley Colours Ltd.), Mr. F. Burrell (J. W. and T. A. Smith Ltd.), Mr. A. S. Callaghan (Imperial Chemical Industries Ltd., Dyestuffs Division), Mr. C. G. A. Cowan (Cowan Bros. (Stratford) Ltd.), Mr. H. Gosling (Cornbrook Chemical Co. Ltd.), Mr. J. H. Grimshaw (Horace Cory & Co. Ltd.), Mr. V. Watson (Cromford Colour Co. Ltd.), Mr. H. A. Wilson (The Derby-Oxide & Colour Co. Ltd.), Mr. C. E. Young (Hardman & Holden Ltd.).

Mr. Allan J. Holden is secretary.

EVENING COURSES IN SPRAY PAINTING FOR PAINTERS AND DECORATORS

THE eighth short course in spray painting will be held at the L.C.C. School of Building, Ferndale Road, London, S.W.4, from Monday, 11th January, until Tuesday, 30th March, 1954. These courses are in two grades, Elementary and Intermediate, each of twelve weeks' duration requiring an attendance of two evenings each week.

They are intended for craftsmen with adequate industrial experience who wish to broaden their knowledge and skill in this branch of the painting and decorating trade. Students who have already taken the Elementary Course may proceed to the Intermediate Course, subject to satisfactory progress being made. At the conclusion of each course, an examination is held and a report is issued on the work done.

Intending students should apply to the Secretary at the School for an enrolment card, which should be completed and returned as soon as possible. Those students who reside and work outside the L.C.C. area should obtain the required authority to attend these classes from the Education Officer of the county in which they reside and attach it to the completed enrolment card.

Days and Times of Classes

Elementary grade: Mondays and Tuesdays, 6.30–8.30 p.m.
Intermediate grade: Mondays and Tuesdays, 6.30–8.30 p.m.

The classes will be held in the Spray Painting Workshops of the L.C.C. Brixton School of Building Annexe (Building Trades Department) at 56/57 Barrington Road, Brixton, S.W.9. (Nearest railway station: East Brixton.)

Fees are payable in advance and are not transferable or returnable. After the first class of the course, no student will be admitted to the work of the class until the fee has been paid. The fee for the twelve weeks' course (Elementary or Intermediate) is 12s. 6d. for students resident within the L.C.C. area. Cheques should be made payable to the "L.C.C. Brixton School of Building" and crossed.

COLOUR AND DESIGN FOR PAINTERS AND DECORATORS

THE fourth short course in Colour and Design at the L.C.C. School of Building, Ferndale Road, London, S.W.4, will commence on Friday, 15th January, 1954, at 6.30 p.m. The courses are of twelve weeks' duration and require an attendance of one evening each week.

These courses are specially arranged to deal with the particular problems of the painter and decorator and to stimulate and suggest ideas in the use of colour in decoration. The lectures and demonstrations include colour theory and its practical application, artificial light and colour, colour mixing, historical colours and the preparation of colour schemes.

Times of classes: Friday, 6.30-8.30 p.m.

Enrolment and fees: Intending students should apply to the Secretary at the School for an enrolment card. The fee payable for students resident in London or whose firms have their headquarters in London is 12s. 6d. for the course.

Students who reside and work outside the L.C.C. area must apply to their local Education Authority for a voucher if they wish to be admitted at the London fee. Fees are payable in advance and are not returnable. Cheques and postal orders should be made payable to the "L.C.C. Brixton School of Building."

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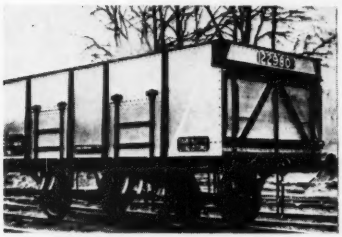
Unpainted Aluminium Railway Rolling Stock



WE recently published a description of an unpainted aluminium alloy Underground train in service with London Transport. In that particular case the aim was, of course, lightness and fuel saving. Lightness, however, is not the only asset that aluminium has to offer the railway engineer, and this is well illustrated by the history of a 21-ton mineral wagon that was experimentally plated with aluminium in 1945. At that time, when many coal producers owned their own wagons, the railway companies were charging a lower haulage rate for coal carried in large (21-ton) wagons, owing to their better gross/tare ratio. There was thus an incentive to improve the efficiency of these wagons still more in order to be able to press for a further reduction in the haulage rate.

This led the Cambrian Wagon Works Ltd., of Maindy, Cardiff, to contemplate building a prototype all-aluminium mineral wagon, and Northern Aluminium Company Ltd. were asked to give their recommendations as to choice of alloys and thicknesses. The builders finally decided to use aluminium for the plating only (in the same thicknesses—3/16 in. for sides and ¼ in. for floor—as the normal steel plate), retaining a steel frame and hot-driven steel rivets. Tare was then 8 tons 17 cwt. 3 qrs., compared with 10 tons 3 cwt. for all-steel construction. The unpainted wagon was put into service with a private owner, carrying coal and coke.

The demand for lighter wagons did not materialise, and, after nationalisation, all privately owned stock was purchased by the Railway Executive. The prototype wagon, however, remained in service and has on three occasions been examined to discover the behaviour of the aluminium in the extremely arduous conditions. From the last of these inspections, made jointly in January 1953 by the Railway Executive, Aluminium Development Association and Aluminium Laboratories Ltd. (on behalf of Northern Aluminium Co. Ltd.), it was evident that, even if weight-saving was completely discounted, aluminium was an excellent material for the job on the grounds of durability alone.

Conditions from the corrosion point of view were severe. In composite structures of aluminium and steel, unless thorough protective treatment is given, there is always a possibility of galvanic interaction at bi-metallic joints in damp surroundings. In this wagon it was possible to apply paint between mating surfaces during construction, but any protective paint applied to rivet heads and other exposed surfaces would quickly have been abraded away. Various niches and crevices in the body were filled with damp coal dust, giving very unfavourable "poultice" conditions. A large part of the wagon's life had certainly been spent in more or less polluted atmospheres.

Nevertheless, the recent examination showed the plating to be in a sound and serviceable condition after seven years' work. There was an adherent deposit on the metal which, when removed, showed that general surface attack, indicated by a whitish deposit, was very slight. It was most marked on the underside of the floor and at the lower edges of the sides, where moisture would tend to persist, and adjacent to steel members. Localised corrosion had taken place only in a few isolated instances where dust and moisture had been trapped between steel angles and the plating, and at the side of one rivet head. The edges of the plates were still sharp-cornered and uncorroded.

The general condition of the wagon contrasted very favourably with that of steel wagons of similar age in the same service. It is normal practice to paint the outside of steel wagons every five years, and after seven to ten years the lower part of the sides usually needs repair or replacement. It seems evident that the unpainted prototype aluminium wagon should give years more service before needing serious repair, and its behaviour will be watched with interest.

Plating Rifled Gun Barrel Interior Bores

Mass Production Set-up at the Oldsmobile Tank Gun Plant

PLATING of the inside bores of the 90 mm. cannon, on a mass production basis is now being carried out in the Oldsmobile Gun Plant at Lansing, Michigan, U.S.A. The ingenuity of the motor trade engineers in co-operation with the U.S. Army Ordnance engineers from Watervliet Arsenal enabled the difficult operation of plating the interior of the 15 ft. gun tube to be carried out on a continuous basis by the use of specially designed equipment and a special 30 ft. deep plating vat.

The photographs, reproduced by permission of the Oldsmobile and Army Ordnance Authorities, show how the central anode is rigged and held in place by spacers and clips whilst the barrel is lowered into the plating vat. How the process was planned and set up was described by J. V. Wolfram, vice president of General Motors Corporation and general manager of the Oldsmobile Gun Plant.

"Plating to a fine tolerance inside the 15 ft. gun tube was specified so that the cannon would hold its accuracy longer," said Wolfram. "We assigned the task to a group of Oldsmobile engineers in the process engineering and plant engineering departments. This group worked closely with Watervliet Arsenal in adapting the plating method to mass production. Their knowledge of plating processes and equipment installations had been gained in regular motor trade work—such as on bumpers, radiator grilles and body trim. They started from scratch last year and in the short period of five months, volume plating at Oldsmobile was a fact."

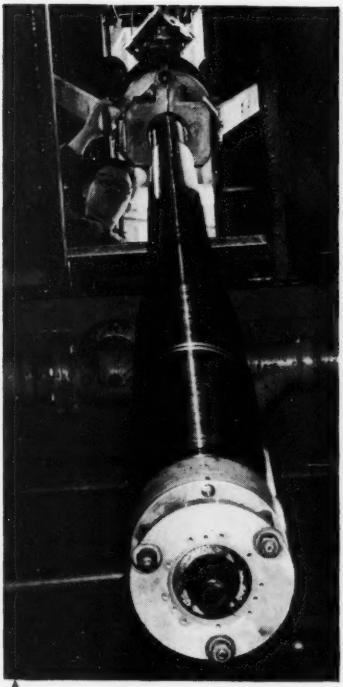
The accomplishment is best appreciated, the Oldsmobile executive stated, by looking into the bore of a 90 mm. cannon. The spiral rifling shows up mirror-like in its smoothness. This gleaming surface resists wear better and thereby lengthens the life of the grooves which form the rifling.

To accomplish the goal, Oldsmobile chemical engineers visited arsenals, studied their methods and learned what end-results Army Ordnance desired. The next step was to borrow on knowledge gained in practical automotive plating and devise a process for military use which would solve the problems of uniform plating thickness and adhesion. Mechanical engineers then took this process information and worked out the location of equipment and means of handling the cannon in a necessarily complex routine of operations.

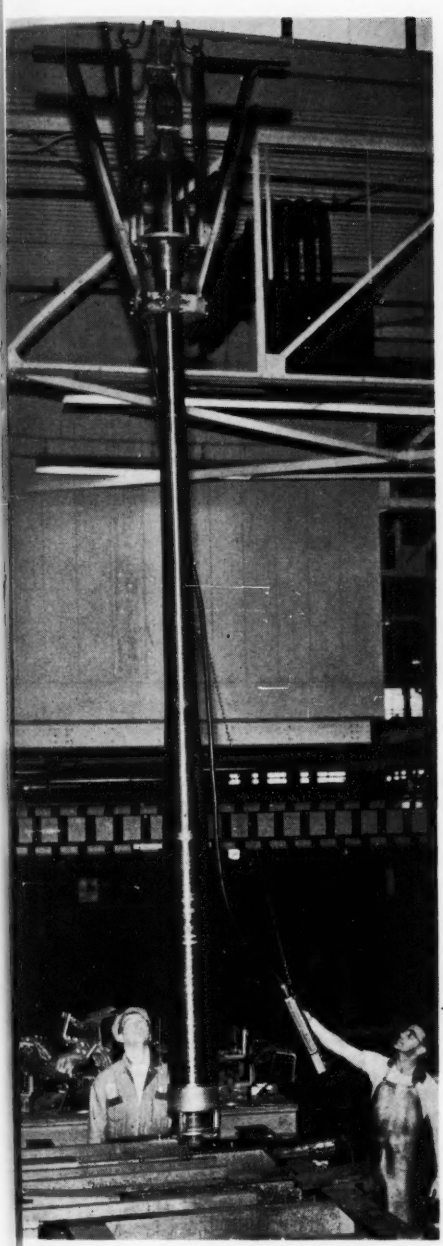
Meanwhile, electrical engineers and civil engineers of the plant engineering department designed the entire electrical system, the 30 ft. pit for solution tanks and control machinery and the supporting structure. These same engineers ordered the equipment and followed through on construction. As an example of how the installation was expedited, a crane was designed and built in the Oldsmobile plant in order to save time that would have been lost in waiting for delivery from a crane manufacturer.

During operation of the plating installation, some of the specialised engineers remain in the production picture. Chemical engineers constantly check on the efficiency of controls and apparatus, while other engineers supervise maintenance.

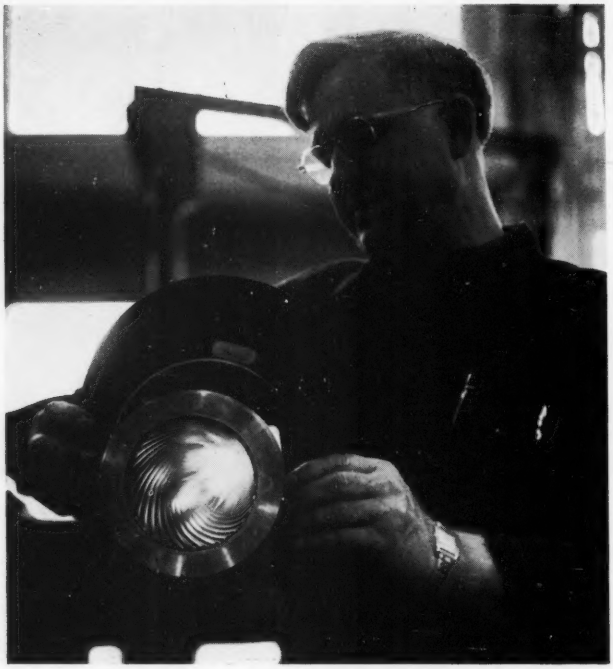
Wolfram pointed out that precision control and cleanliness of steel surfaces are highly important factors in the plating installation. Five preliminary steps assure a completely clean gun bore and an accurately fitted anode. The anode is held in position by special fixing devices which locate



Useful life of 90-mm. tank gun tubes is prolonged by plating the rifled inner surface of the barrel. Subterranean view of the tube being lowered into one of the deep plating tanks. The anode for the electrolytic process has been inserted and the employee is guiding the tube into the plating solution. Temperature of the plating solution is carefully regulated



Here employees in the Oldsmobile gun plant are raising one of the 15-ft tubes from the plating tank after the electrolytic process is completed. The plating cycle may take up to 4½ hours for completion. The anode for the plating process is inserted in the tube from the upper muzzle end of the gun. The plating tanks are 30 ft. deep to accommodate the lengthy barrels



This photograph, taken as an employee gauges the outside diameter of the gun barrel tube, reveals the bright plated rifling on the inner surface. It is claimed that this resists wear and gives the gun a much longer active service life

it in relation to the inner surface of the tube.

The Oldsmobile general manager explained that most military equipment production in private industry in America is achieved through the co-operation of the Army Ordnance engineers with automotive industry engineers thoroughly familiar with mass production. Full details of the solutions, plating times and methods are, of course, regarded as security information and cannot, as such, be published in open literature but the outline given above is sufficient to show the extent to which ordinary commercial "know-how" is being adapted to satisfy specialist demands.

A NEW PROJECT GROUP

HEAT-USING appliances are the speciality of a new group which is headed by James Scott Smith, the industrial designer, and Dr. B. J. Zaczek, Ph.D., D.I.C., Dipl.Ing., A.M.I.Mech.E., the heat transfer expert.

Their intention is to apply scientific theory to the design of all types of heat-using appliance, especially domestic appliances.

In announcing this, Step Ltd., Abbey House, Victoria Street, London, S.W.1 (telephone: Abbey 5807 and Whitehall 0606), invite enquiries from manufacturers and traders.

Paints and Finishing Materials Extracted from Coal-Tar

AT a meeting of the London and Southern Junior Gas Association, a few weeks ago, Dr. J. R. Dewhurst, B.Sc., A.R.I.C., M.Inst.Gas E. of the South-Eastern Gas Board, presented a paper dealing with the products of the coal-tar industries and, as the section dealing with paints and preservatives is of undoubted interest to the finishing shop, we are reproducing extracts from the parts of Dr. Dewhurst's paper dealing with those materials.

The author pointed out that coal-tar is an extremely complex mixture of substances, which may be roughly divided into those of acidic, basic and neutral character. It is not so much the number of uses as their apparent diversity which is so surprising; fuels and paints, roads and sheep dips, electric conductors and electric insulators, explosives and adhesives, moth balls and armour plating. The contrasts are astonishing.

Creosote Wood Preservative. Coal-tar creosote is perhaps the most outstanding wood preservative. Provided it is properly applied, i.e., provided there is adequate penetration of the wood, total protection is afforded against fungus and insect attack for a remarkably long period. There seem to be only two drawbacks, the smell makes it unsuitable for most indoor uses and its colour and solvent power make it impossible to use on timber which is to be painted.

The need for good penetration has led to the adoption of a variety of methods of application. The most effective make use of pressure. The timber is stacked on trucks which are run into a large cylindrical vessel with pressure-tight doors. Creosote at 150° C. is pumped in, the pressure raised to between 100 and 180 lb. per sq. in. and held for the required period. The creosote is then pumped out and the timber removed. Some woods are too dense and their pores too sealed to permit ready penetration; these may be given longer treatment, but in general must be accepted as less amenable to protection. The second most effective method, which is very applicable to stakes and posts, consists of steeping the wood in the creosote which is then raised to about 100° C. and allowed to cool. While brush application is quite satisfactory for porous deal fences, it is totally inadequate for protection of the buried parts of stakes and posts. Pressure impregnation or steeping is then essential.

Coal-tar Paints are perhaps the most important water-proofing product of tar. These are usually prepared by mixing a soft pitch with a suitable, low boiling coal-tar naphtha or even benzole to give a consistency which is suitable for brushing. These simple coal-tar paints, often known as "black varnish" can give very good protection of steel if they are properly applied. The steel must be clean, free from grease, rust and loose scale and the applied film must be continuous and of adequate thickness. If these requirements are fulfilled, good protection is achieved and if after some twelve months a subsequent coat is applied, no further treatment will probably be needed for a period of years. The paints are protective and not decorative so that although they have a good glossy finish when first applied, the continuance of this gloss should not be expected.

The simple solvent-type tar paints suffer from certain drawbacks. The high temperature susceptibility of the paint means that if it is sufficiently viscous for good application during the heat of the day, it is much too viscous in the early morning when painting starts. Thus, it drags on the brush and the film is thick. On vertical surfaces this thick film sags when the temperature rises and forms "runs."

The Newtonian flow properties of the dried paint film mean that similar "runs" may develop where the correct thickness is exposed to direct sunlight on vertical surfaces.

Loss of oils, polymerisation of resinous matter and oxidation by the atmosphere result in the formation of a surface skin on the dried paint. Continued action of light and air, coupled with temperature changes, causes shrinkage of the skin and cracks form to give a typical "crocodile" pattern. These cracks rarely penetrate the whole film but clearly they weaken it and reduce the protection.

A number of methods have been employed for overcoming these faults. The addition of a suitable type of lamp-black imparts thixotropy to the paint. This means that the viscosity is reduced under stress and returns to the higher value when the stress is removed. After standing, the paint appears stiff (or even paste-like), but when stirred it "breaks down" and becomes fluid. It is the "broken-down" viscosity which matters when the paint is being brushed. This is low and, therefore, brushing is easy. When the brush has passed the paint "sets" and the viscosity then being very high there is little or no tendency for the film to sag. Such paints are as easy to apply in the early morning as in the late afternoon.

The presence of the lamp-black in the dried film imparts "structure" to it, thus reducing the tendency to form "runs," but the surface skin also receives added support so that although it may be split by temperature or other changes, the cracks are never so wide and the protection is not greatly affected.

Two warnings about tar paints should perhaps be included. They are not compatible with petroleum solvents so that in no circumstances should white spirit or paraffin be used as thinners and these solvents are not suitable for cleaning brushes. Tar paints contain certain chemical compounds which prevent the drying of linseed oil. If then a tar paint is applied to a fresh linseed oil paint the film remains soft indefinitely. It is necessary to allow the linseed oil paint to become thoroughly hard, three to four weeks, before applying the tar paint.

Tar emulsion paints are prepared by emulsifying soft coal-tar pitch in water containing suitable emulsifying agents, usually soaps with casein as a stabiliser. The emulsions, like road tar emulsions, are reasonably stable in bulk but when spread in a thin film, break down as a result of evaporation of the water and leave a film of pitch which forms the protective coating. These paints have the advantage that they can be applied to wet surfaces provided the conditions allow them to dry out afterwards. A disadvantage is the risk of breakdown of the bulk through the action of frost or merely because of prolonged storage. In general, emulsion paints do not give such good protection as the solvent type because the films tend to be porous.

Dipping compounds are used for protecting light metal articles, steel and cast-iron pipes. They are of two types, those use hot and those used cold. The former usually consist of a thin tar which is kept at 60-80° C. in a large tank. Evaporation losses, which harden the tar, are made up by adding creosote. The articles, usually pipes, are dipped while hot; on being removed they are allowed to drain and then cool. The protective film is usually very thin and is, therefore, liable to be damaged in transit. Pipes protected by this process were included in a recent series of tests on the protection of buried metals and gave good performance considering how thin was the protective film. It is unfortunate that the report appeared to indicate that bitumen is the better protective when in fact the comparison was between a film of pitch 1/500-in. thick or less and bitumen $\frac{1}{8}$-in. thick or more.

Cold dipping compounds are very thin tar paints made with a low boiling solvent to ensure rapid drying. They are usually based on water-gas tar, but coal-tar pitch has been used successfully.

Hot applied coal-tar enamels (so-called) are usually filled soft pitch and are used for producing thick coatings on steel pipes and bulkheads of ships. Their great virtue is resistance to lubricating oils and petrol; their main drawback is the flow properties of coal-tar, partly overcome by the inclusion of suitable fillers.

RECENT DEVELOPMENTS

MATERIALS : PROCESSES : EQUIPMENT

ENAMELLED PRESDWOOD

AN interesting addition to the range of Masonite "Presdwood" panels is the enamelled series, shown recently at the Motor Show. These panels, in a wide range of colours and patterns, are now available ex stock in standard sizes. They are in plain or tile pattern and in marble designs, colours are black or green and imitation woods in birch and natural light colour are also available.

We are told that anything that can be photographed can now be reproduced in any colour and perfect imitations of marble and the grains of fine woods can be supplied to special order; while the grains of walnut, mahogany, oak, maple, etc., are in regular production and can be supplied at short notice.

The prefinished surface, of course, makes it possible for both the amateur and the professional to employ a material which has an appearance of well-finished wood with the assurance that it will have all the qualities and durability of ordinary wood.

A special leaflet is available describing the material and giving details of the finishes available.

FORCED-AIR CIRCULATION OVEN

A VERTICAL, manually operated, forced-air circulation conveyor oven which is being manufactured by The General Electric Co. Ltd. occupies a minimum of floor space. It will give a prolonged heat treatment but will also enable heat-treated parts to be delivered individually as required.

The oven is of double cased construction and is well insulated. Inside the oven are twelve perforated swing trays, suspended from rods, which are brought to the unloading position by means of twin chain conveyors running over sprocket wheels. These wheels are turned through reduction gears by means of a manually operated handle, mounted on the exterior of the oven. The trays can be loaded or unloaded from either side of the oven, and the conveyor equipment can be operated from either side. The oven is rated at 25 kW. for operation at 250° C. on a three-phase, four-wire supply. Its heating elements are fitted in a separate case, situated outside the oven body between the fan outlet and the oven. The centrifugal fan is directly connected to a three-phase induction motor.

The oven is equipped with automatic control and is provided with an excess temperature cut-out. Associated switchgear and temperature indicators are mounted in a separate cubicle. If required the oven can be supplied for use with special atmospheres.

NEW AND AMENDED SPECIFICATIONS FOR LACQUERS, PAINTS AND INKS

THE Ministry of Supply Chemical Inspectorate have issued a number of new specifications as follows:

C.S. 2709: Lacquer, for the interior of containers, ointment prophylactic.—Protective coating for the interior of tinplate containers for ointment prophylactic.

C.S. 2710: Lacquer, for the interior of containers, ointment prophylactic, stoving.—Protective coating for the interior of tinplate containers for ointment prophylactic.

C.S. 2715: Ink, stencilling, special.—To cover a stencilling ink suitable for application from a felt pad by means of a gelatine or synthetic rubber roller. Supersedes T.S. 175 C. (See below.)

C.S. 2716: Paint, finishing, water-resistant paint, undercoat, water-resistant.—For the protection of woodwork which is liable to be immersed in water for prolonged periods.

C.S. 2717: Paint, textured, matt finish, stoving.—A disruptive finish for use on steel helmets.

C.S. 2718: Paint, priming, aluminium, for metal.—Primer for the protection of steelwork, particularly for use when

painting is unlikely to be completed for several weeks.

Copies of these are obtainable from Chemical Inspectorate, M.O.S., Block A 14, Station Approach Buildings, Kidbrooke, London, S.E.3.

NEW "ROTOFINISH" MIDGET MACHINE

A NEW "Midget" machine, the DW/16/16/2, has been introduced by Rotofinish Ltd. for use specially with Rotofinish compounds. The machine is designed for the finishing and deburring of small parts such as are used in the camera, clock or radio industries.

A choice of barrel sizes is available, either 16 in. long and 16 in. across the flats, divided into two separate compartments if required, or for particularly small parts or batch quantities, a smaller sized barrel only 12 in. across the flats.

Solutions are sluiced out from a drain in the side of the machine and sliding trays are provided under the barrel in which a set of interchangeable screens are fitted to enable separation between different sizes of parts and the "Rotofinish" Grinding or Britehoning Chips. Normal separation procedure allows the chips to flow through the screens into the self-contained hoist-pan fitted in the slides under the trays.

6 ft. 9 in. including control panel; width, 2 ft. 9 in.; and height, 7 ft. with hood in raised position. A special leaflet describing the machine is available from the makers.

CHROME PLATING BARREL

THE illustration here shows the new low-priced barrel for bulk plating of small chrome parts recently introduced by Canning and Co. Ltd., of Birmingham.

The new barrel has several special features. It is, of course, provided with efficient and satisfactory exhaust ducting for fume removal as required by law. The conical barrel is self-emptying and is driven by a geared motor unit. The exhaust fan is also motor driven and the hood which covers the top when the machine is working can be swung back to open up the machine for unloading.

The barrel is raised by hydraulic lifting gear and a control pedestal is provided, at the side of the machine, which carries the motors, switches and electric meters. The main tank is water-jacketed and a special emptying tray is incorporated in the top to receive the contents of the barrel when unloading.

The overall dimensions are: length,

STEAM TEMPERING FURNACE

THE use of controlled atmospheres in heat-treatment practice is well known and recognised to be advantageous for many applications, such as the prevention of oxidation, decarburisation, etc. Atmospheres derived from town's gas, bottled hydrocarbons and ammonia are most common and steam has been used in the annealing of some non-ferrous metals for many years.

Recent developments in the use of steam during tempering and secondary hardening processes carried out by the research organisation of Wild-Barfield Electric Furnaces Ltd., of Watford, has led to improvements in the life of tools,

giving at the same time a distinctive and attractive colour to finished components. The process may be applied during the normal tempering treatment or as an additional treatment. It has been found, for example, that when steam tempering is applied to cutting tools after final grinding and polishing, they can be despatched to the customer with the condition of the fine cutting edges unimpaired. Moreover, the blue oxide finish of the surface is both pleasing to the eye and provides enhanced corrosion resistance properties. Pickling operations are eliminated.

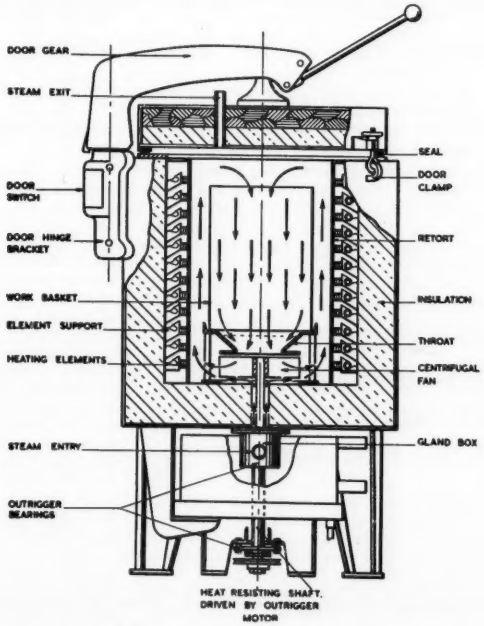
The blue oxide surface on high speed steel tools provides a barrier between the tool and the work being machined, thus preventing chips from "welding" to the cutting edge, and acts as an oil retainer which improves lubrication both at the point of contact and in the area over which the chips slide.

It is important that the plant for steam tempering is specially designed for the job. Normal heat-treatment furnaces may cause excessive consumption of steam with resultant higher operating costs and indifferent technical results. It is also necessary for the furnace designer to have much experience on the design and manufacture of the type of furnace found most suitable for this process. For example, the furnace must have a powerful fan with which to cause a constant, penetrating and even flow of steam over and around the work to be treated. The transference of heat to the work must be as rapid as the work can absorb the heat.

Details of a new Wild-Barfield equipment designed specifically for steam tempering show that the new furnace follows closely their already well-known vertical forced air circulation furnaces of which many hundreds are in use all over the world.

The design, however, allows for many conditions not normally vital in a forced air circulation furnace. The chamber contains a retort for sealing off the effective working space, thus ensuring precise control of atmospheric conditions, whilst positive circulation of the steam within the retort by means of a centrifugal fan in the base is considered imperative. Further, the retort is the minimum size consistent with the work basket dimensions enabling a corresponding reduction in operating costs to be effected.

A section through the furnace is shown in the accompanying schematic diagram where it will be seen that the steam is supplied to the gland box below the chamber, travels up the space around the fan shaft and enters the chamber where it flows over and around the work in the



Right: diagram shows the internal structure, elements and circulation system of the steam tempering furnace

charge basket.

The door, of the lift and swing aside type, is sealed and provided with four clamps. A steam exit is let into the top of the door. Heating is by means of nickel-chromium coil type elements mounted in the annular space between the wall and the retort.

A throat in the base of the chamber helps to direct the flow of steam and protects the fan from any work which may be dropped into the retort; also forming a platform on which the work basket can rest. The fan shaft assembly is fully protected against the effects of heat and steam and the shaft is driven by a standard motor through a belt and pulley.

From the foregoing, it will be clear that steam tempering is a process with many advantages but requiring no special skilled labour and a furnace as simple to operate as the normal air circulating types generally in use to-day.

Extensive field trials in the machine tool and other industries have shown very favourable results and advantages can be summarised as follows:—

1. In the case of high speed steel and carbon steel tools, dependent upon their type and duty, a longer life can be expected. Improvements ranging from 100 per cent. to 200 per cent. have been reported regularly.
2. Test-life figures for drills show a considerable rise on the average and results are as good as the best quality drills produced by other treatments.
3. Improved appearance on both tools and engineering components is an important sales point.
4. The elimination of pickling operations and improved corrosion resistance properties are brought about by the controlled oxidation.
5. The distinctive colour finish gives visual proof that the treatment has been carried out.

AIR COMPRESSOR DRIVEN BY FRACTIONAL HORSE-POWER MOTOR

THE illustration shows a Compton portable air compressor made by Dawson, McDonald & Dawson and powered by a Hoover fractional horse-power motor.

The flange-mounted construction makes a neat and very portable unit and eliminates a driving belt. A control switch is fitted on the terminal cover.

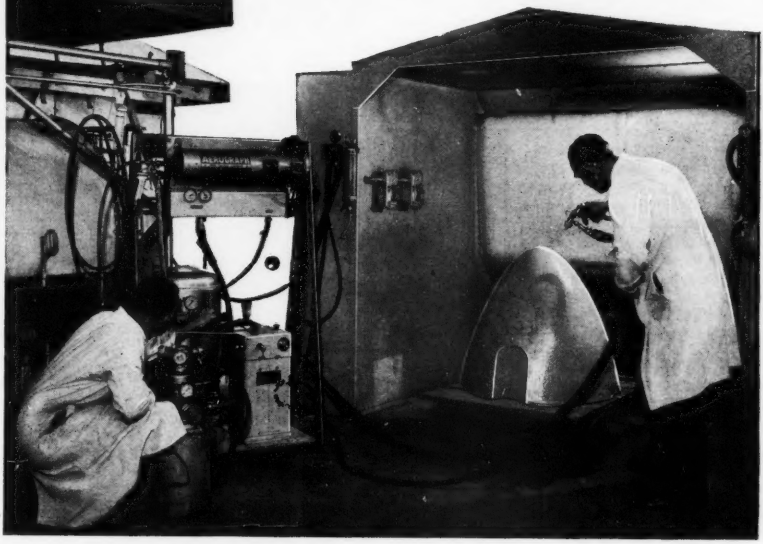
This is a diaphragm type compressor and thus an absolutely oil-free air supply is ensured. This feature makes the machine especially suitable for use in laboratories, for food processing, for chemical engineering, and, of course, for paint spraying—a purpose for which thousands of Compton machines are at present in use.

NEW TECHNIQUE FOR BRAZING STAINLESS STEELS IN A CONTROLLED ATMOSPHERE

IT is essential when making brazed joints that the surfaces to be joined are kept clean so that the brazing metal may wet them freely; the necessary cleanliness may be achieved either by the use of flux or by brazing the component in a controlled atmosphere. Fluxes usually have the disadvantage that they need to be completely removed after brazing to prevent subsequent corrosion. On the other hand, brazing of stainless steel in a controlled atmosphere has not always proved consistently satisfactory. A technique whereby the brazing of stainless steels can be carried out in a standard furnace provided with a controlled atmosphere has now been developed by The General Electric Co. Ltd. The process is suitable both for copper-brazing stainless steels and for brazing components using Nicrobraz alloy as the filler metal.

The protective atmospheres most widely used in the process are burnt town's gas or burnt ammonia. The brazing of metals which are not easily oxi-

HOT SPRAY PAINTING



How to Control the Finish—from the Start

The great advantages of Hot Spray painting are only just being realised. For many industrial purposes the use of the pre-heating process will give an excellent finish much more quickly, with less labour and with an appreciable saving in cost.

For those who want to know more about it, the Demonstration Centre offers full facilities for practical demonstrations on customers' own products. What is more, we will gladly train paint-shop operatives at specially arranged short intensive courses—at no cost or obligation to the customer.

This is *your* opportunity to gain impartial and unbiased advice on the process that is revolutionising many industrial finishing procedures. If the process is suitable for *your* product, we will show you how best to use it. If it is *not* suitable we will save you expensive "trial and error".

The photograph shows a corner of the Demonstration Centre with operators hot-spraying synthetic enamels at the water-washed spray-booth. Three types of paint heaters are shown in the illustration. Take advantage of this "know-how" and let us help you to *control* your finish.

Just write to—

Demonstration Centre

JOHN HALL

JOHN HALL AND SONS (BRISTOL AND LONDON) LTD · HENGROVE · BRISTOL 4

dised, such as steel, may be carried out in these atmospheres, using filler metals such as copper or copper alloys. However, when components of the stainless steel type are to be treated it is necessary to maintain close control over the quality of the atmosphere within the furnace chamber. Traces of oxygen, water-vapour or carbon dioxide will form an oxide film on the surface of the components which prevents the liquid brazing metal from alloying with the exposed surfaces and a sound joint being made. Similar considerations apply when the brazing alloy itself is readily oxidised, as is the case with certain high temperature brazing alloys such as Nicrobraz. If a very dry hydrogen atmosphere is used and if treatment is carried out in a metal container, the surfaces are kept clean and brazing is satisfactory.

A G.E.C. vertical cylindrical furnace with gas-tight container has given excellent results when used for the process. Fig. 1 shows the container assembly of a G.E.C. 60 kW. vertical cylindrical furnace. It has effective loading dimensions of 17 in. diameter by 4 ft. 10 in. deep and can be used for all types of brazing in the temperature range 700°–1,180° C. The method of operation is as follows:—

(a) After loading the stainless steel assemblies on the support casting, the pot is sealed and immediately purged with the dry hydrogen protective atmosphere. If it is considered desirable, the pot may first be purged with nitrogen.

(b) The pot is loaded into the furnace and the charge brought to the required temperature in the controlled atmosphere and held at that temperature for between 10 and 30 minutes, depending upon the brazing alloy being used.

(c) The pot is removed from the furnace and cooled under the protective atmosphere.

The holding time at high temperature is short; for most filler metals 10 minutes is sufficient but when Nicrobraz is used a suitable holding time has been found to be 30 minutes.

Fig. 2 shows a component which has been made up by the G.E.C. Nicrobrazing technique. On the left a mild steel

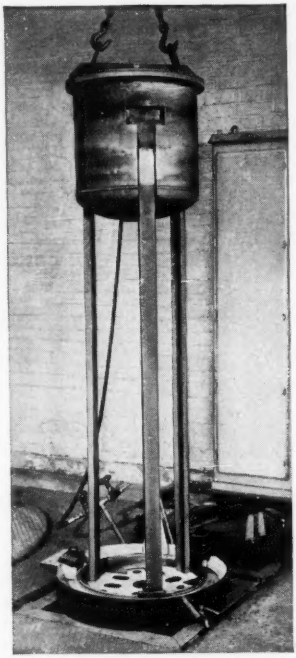


Fig. 1. The container assembly of a vertical furnace for stainless steel brazing

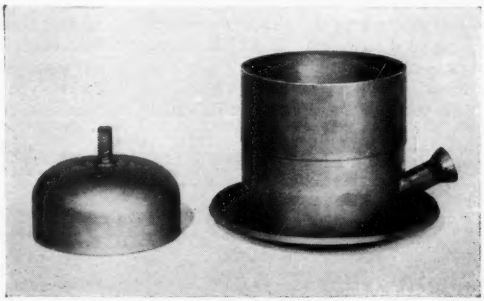


Fig. 2. A pair of components in stainless steel, made up by the brazing technique

stud has been brazed into a nickel alloy cup and on the right joints have been made between the upper and lower cylinders and between the lower cylinder and the spout. The materials of the latter component are mild steel and nickel alloy. Nicrobraz was selected for the brazing alloy because of its resistance to corrosion. The principal application of the Nicrobraz alloy, however, is for high temperature service where the high strength and oxidation resistance of the joints are fully utilised.

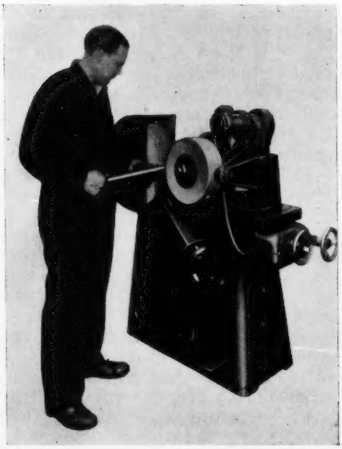
W. Edwards and Co. Ltd., late of Sydenham, inform us that the move of their research, design, production and sales departments to Crawley is now complete. The future address for all departments is now: Manor Royal, Crawley, Sussex.

CENTRELESS POLISHING

ALTHOUGH, by no means a new introduction, the machine illustrated below will be of undoubted interest to the polishing shop having a range of rod or tube work. It is designed to handle work up to 3 in. dia.

A special feature in design gives a constant peripheral speed on the mop, compensating for mop wear, i.e., the same peripheral speed is obtained when using a 16-in. dia. mop as when using a 12-in. dia. mop. The feed gear is a self-contained motor-driven unit.

It is marketed by Canning and Co., of Birmingham.



"The Structure and Mechanical Properties of Copper-Manganese-Tin Alloys"

By J. C. Blade, B.Sc., Ph.D., and J. W. Cuthbertson, D.Sc., F.I.M.

A NEW publication, "The Structure and Mechanical Properties of Copper-Manganese-Tin Alloys," has recently been issued by the Tin Research Institute. It describes a range of new alloys which may be useful in the fields hitherto served by nickel silver. The alloys meet the demand for a white metal with good mechanical properties at a competitive cost. It can readily be cast, forged, rolled, stamped, etc., and has an adequate resistance to corrosion. It is satisfactory as a basis metal for the usual plating finishes used in industry.

The publication gives detailed information on the properties of a wide range of compositions and indicates how compositions and methods of treatment may be varied to give strength, colour or deformability, etc., as may be required.

Of special interest is the fact that the new copper-manganese-tin alloys may effect a useful economy in nickel during the present scarcity, but field trials suggest that they may make a permanent addition to the copper-base alloys used in industry.

Copies of this paper, originally published in the Journal of the Institute of Metals, may be obtained gratis from the Tin Research Institute, Fraser Road, Perivale, Greenford, England.

The address of Aerostyle Ltd., has been changed from 170-176 St. John Street, London, E.C.1, to Sunbeam Road, London, N.W.10. The new Telephone No. is: Elgar 3464.

SHELL REDUCE NONANOL PRICES

A reduction of £25 per ton in the price of their Nonanol is announced by Shell Chemicals Ltd. As from the 1st December, 1953, a price scale will operate ranging from £195 per ton for small lots in 5 gal. drums to £150 per ton for 500 tons in 40/45 gal. drums. Like "Alphanol" 79, the price of which remains unchanged, Nonanol is a higher primary alcohol with important applications as a chemical intermediate, in surface coatings and in plastics.

Tests for Use on Vitreous Enamel Finishes

ENAMEL has a considerable resistance to wear and that resistance may be classified as either resistance of the surface to abrasion or resistance of the underlying structure to crushing. Abrasion is caused by scrubbing a surface with an abrasive but both kinds of wear may be caused by scratching or gouging a surface. If the surface is penetrated then the understructure is crushed.

To the finishing inspector it is important to know the various tests which can be carried out to determine the nature and extent of the wear.

Gouge Test

The gouge test is used to determine the resistance of enamels to gouging. This test primarily measures the resistance of the underlying structure to crushing; however, to a limited extent the resistance of the surface to abrasion is also measured. In the gouge test, a small steel ball is rolled on a sample under different known loads and the magnitude of the load required to gouge the enamel is determined. The gouge test is divided into two portions: the constant load and the varying load.

In the constant load portion a series of strokes is made, each with a greater load than the previous stroke. With loads of low magnitude no effect is apparent to the naked eye. As the load is increased on successive strokes, a magnitude will be reached at which the ball will penetrate the enamel over a small portion of the path of the ball. On the following stroke, at a greater load, the enamel will be gouged out over a greater portion of the path. With increments of 1 lb. or 2 lb. per stroke eight or ten strokes may sometimes be made within the limits of 10 per cent. and 90 per cent. gouging.

In the varying load portion of the gouge test a longer stroke is used, and the load on the ball is increased continuously. There is a gradual trend toward higher percentages of gouging with an increasing load.

For the end point of either test an estimate is made of the load required for 50 per cent. gouging. This load cannot be determined as accurately with the varying load test, which is ordinarily used to obtain an indication of the range of loadings to use for the constant load test.

Abrasion Test

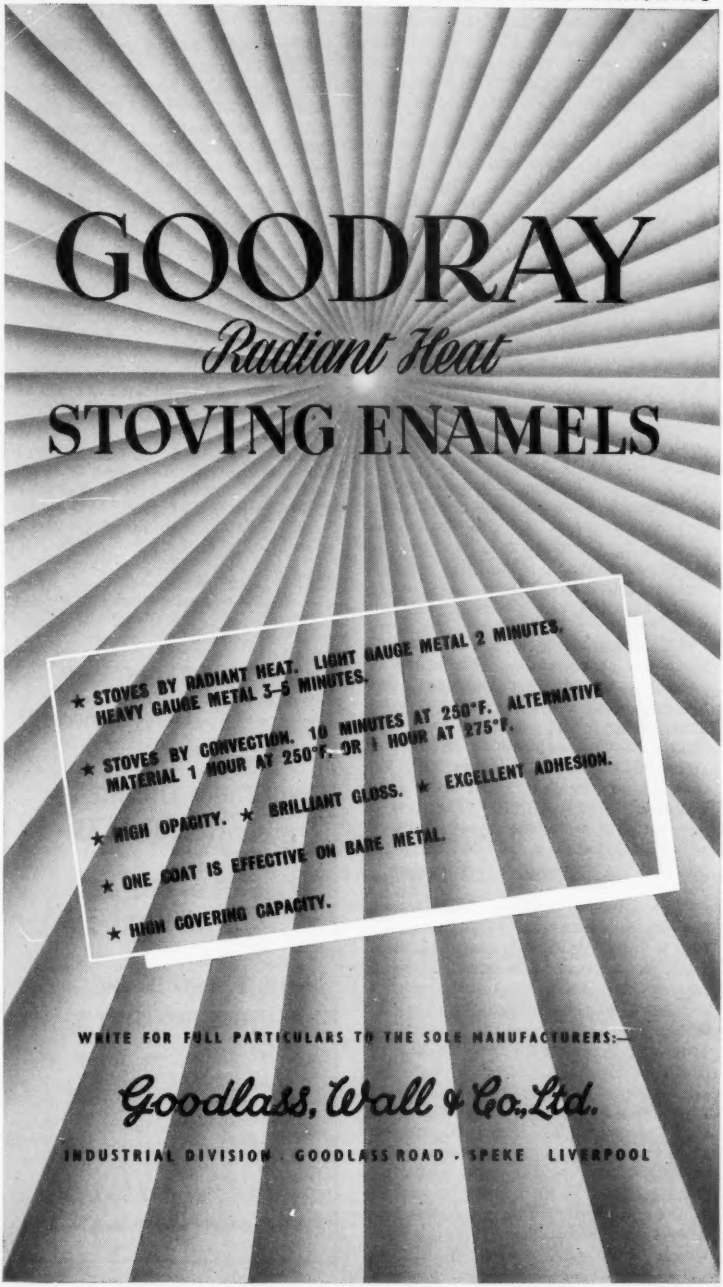
The resistance of enamels to surface abrasion is determined by measuring the gloss of the specimens before and after a specified abrasive treatment and taking the percentage of the original gloss retained.

Reflectance Test

The reflectance test measures the amount of light reflected from an enamelled surface. Light strikes the surface at an angle of 45° (tolerance, ± 4°) and is measured perpendicular to the surface (tolerance, 15° in any direction). These tolerances permit adjustment to eliminate mirror reflections and to get only diffused reflections. Calibrated standards can be purchased, having reflectances of approximately 90, 80, 70, 60, 50, 40, 20, 15, 8, 4, 0·8 and 0·5 per cent. The five plaques having the highest reflectances are satisfactory to determine the reflectance of white enamel.

Adherence Test

The newest test for adherence of porcelain enamel to sheet metal is made with an adherence meter. The meter is an electronic instrument equipped with 169 needle-like probes, which are assembled in a regular hexagonal pattern 1·21 in. between opposite sides and 1·40 in. between opposite angles. Each probe is connected to an electric circuit, which can be completed through the earthed metallic base of the specimen, which has been deformed by using a special die. During the operation the probes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★ STOVES BY CONVECTION. 10 MINUTES AT 250°F. ALTERNATIVE MATERIAL 1 HOUR AT 250°F. OR ½ HOUR AT 275°F.
★ HIGH OPACITY. ★ BRILLIANT GLOSS. ★ EXCELLENT ADHESION.
★ ONE COAT IS EFFECTIVE ON BARE METAL.
★ HIGH COVERING CAPACITY.
WRITE FOR FULL PARTICULARS TO THE SOLE MANUFACTURERS:—
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are lowered onto the deformed area of the specimen. Each probe that touches bare metal completes an electric circuit, thereby actuating a counter which indicates the total number of probes touching the metallic base of the specimen. The assembly is designed to allow rotation to three positions 7-½° apart (total, 15°). Readings taken at the three positions represent three different samplings of the deformed areas.

Acid-resistance Tests

The loss-in-weight and weight-of-residue tests are both used. With the loss-in-weight test the enamel is exposed to an acid for a predetermined time, rinsed and dried. The loss in weight is then calculated in terms of weight per unit are exposed. The weight-of-residue test is similar to the loss-in-weight test but differs in that the material removed from the enamel is weighed. The residue is obtained by evaporating the solution and chemically removing the organic material present. The loss-in-weight test is preferred because it is quicker.

Thermal-shock Test

The thermal-shock test requires a specimen at room temperature to be placed in the centre of a special, preheated electric hot plate and left for a short time. The specimen is then quenched in water. It should be returned to the hot plate and the wattage of the hot plate should be increased every 8 min. The test is over when some of the enamel falls off or when 1,000 watts is reached.

Warpage Tests

The test for warpage of flatware consists of two parts. First, the deviation of the freely hanging specimen from a vertical reference plane is measured. The vertical position reduces the effect of gravity upon the warpage. The amount of twist per unit length indicates stress caused by forcing the specimen when installing it. Second, the specimen is clamped in an installed position, there eliminating the twist. The size and number of waves in the specimen are determined with a dial indicator, supported from a movable, horizontal beam with adjustable legs. This measures the distortion and excess highlighting which would remain after installation.

Impact Tests

These tests measure the resistance of enamel coatings to physical abuse. They are the falling-weight and pendulum tests. The falling-weight test consists of dropping a weight on the specimen from varying heights until the coating is fractured. The results are expressed as energy necessary to cause the fracture or as the height of fall of the fracturing weight. The pendulum test consists of striking specimens with a hammer which is part of a pendulum. The force of each successive blow is increased until the coating is fractured. Both the falling-weight and the pendulum test vary the weight and the point of impact for different applications.

British Insulated Callender's Cables Ltd. announce that with effect from Monday, 23rd November, 1953, the address of their Bristol Branch will be 7–9 Barton Street, Bristol. The telephone number, Bristol 23453–4, is unchanged.

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In addition, the editorial staff of INDUSTRIAL FINISHING *are always available as an advisory service on questions affecting finishing.*

Gas-fired Infra-red Drying Panels. Individual panels permit the layout and arrangement of special shaped tunnels for individual jobs. A leaflet, *Have you a Drying Problem*, describes the panels and makes suggestions for their use. Thomas De La Rue and Co. Ltd., 84-86 Regent Street, London, W.1. (194)

Paints Incorporating Natural Rubber. A booklet describes the types of paints which use rubber in the composition, the purpose of using it, the method of manufacture and the best method of application is discussed. British Rubber Development Board, Market Buildings, Mark Lane, London, E.C.3. (195)

Fully Fume-exhausted and Protected Chrome Plating Barrel. Geared motor drive, hydraulic barrel lifting and built-in control system. A folder describes the machine and its advantages. W. Canning and Co. Ltd., Birmingham 18. (196)

Enamelled Wood Panels. A range of Presdwood panels finished in various colours, grains and patterns is available from stock. A folder gives details and suggestions for fixing, bending and using the material. Masonite Ltd., Bevis Marks House, Bevis Marks, London, E.C.3. (197)

Grainless Wood. A leaflet describes a range of grainless wood panels for use in the caravan, coach and boat-building industries. They are supplied in two grades, standard and tempered. Masonite Ltd., Bevis Marks House, Bevis Marks, London, E.C.3. (198)

Power free of Cost is the title of a leaflet describing a range of steam-driven stirring machines for use where steam is already supplied for heating. The stirrer is driven by a 3-cylinder steam engine. Cannon (CP) Ltd., Deepfields, Bilston, Staffs. (199)

Fluorescent Magnetic Flaw Detection Ink. Lumor ink for the detection of flaws in magnetisable articles is a modern, non-destructive process. The method is des-

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READER SERVICE

cribed in a folder which illustrates the action of the ink on a workpiece. Manchester Oil Refinery (Sales) Ltd., Twining Road, Trafford Park, Manchester 17 (200)

Glomor Flaw Detection Ink is another product of the above firm and is the subject of a separate folder. It is for use on both magnetisable and non-magnetisable materials. Manchester Oil Refinery (Sales) Ltd., Twining Road, Trafford Park, Manchester 17. (201)

Horizontal Batch Type Furnace, electrically operated a.c. or d.c. according to requirements, for vitreous enamelling, normalising, carburising, etc. General Electric Co. Ltd., Magnet House, Kingsway, London, W.C.2. (202)

Bright Nickel Plating saves up to 50 per cent. of polishing costs according to class of work, etc. A folder, showing the flow and layout of a department describes the method and equipment. M. L. Alkan Ltd., Long Drive, Greenford, Middlesex. (203)

Car Washer, electrically driven, two gun, high-pressure model; petrol engine as alternative drive if desired. Leaflet. Williams and James (Engineers) Ltd., Gloucester. (204)

Description of a Finishing Shop for Heavy Chassis. Booklet describes stages in the development of a scheme for a special shop in which Dennis Chassis are finished, air conditioning and ventilation are described. Perfectair Ltd., 314-314a Balham Road, London, S.W.17. (205)

Infra-Red Heating by electric lamps and reflector units. A folder gives details of the radiation powers, sizes, types and fixing methods of a range of equipment. General Electric Co. Ltd., Magnet House, Kingsway, London, W.C.2. (206)

Industrial Infra-Red Plant. Another folder from the same source. Gives details of the construction of certain types of special plant to make use of the infra-red lamps and reflectors described in the first folder. General Electric Co. Ltd., Magnet House, Kingsway, London, W.C.2. (207)

Metal Cleaning. Twelve-page booklet gives details of the Mercol range of cleaning plant and equipment for removing grease, dirt, oil, etc., from parts prior to painting, etc. Diagrams and drawings give examples of the type of plant used. Mercol Products Ltd., Eyre Lane, Sheffield 1. (208)

(*Continued on page* 349.)

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Stationary Air Compressor, 3 c.f.m., 780 r.p.m. and air receiver 15 in. by 30 in. high. For paint guns, cleaners, tyre inflation, etc. Leaflet. Dawson, MacDonald and Dawson, Compton Works, Ashbourne, Derbyshire. (209)

Bright Zinc Plating. A Three-fold brochure describes the Promat system of bright zinc plating and gives details of the electrolyte, operating conditions, etc. M. L. Alkan Ltd., Long Drive, Greenford, Middlesex. (210)

Radiant Heating Panels. Gas-fired panels for space heating, a safe model on the principle of the miner's lamp for use in hazardous atmospheres. Leaflet. Thos. De la Rue and Co. Ltd. (Gas Division), 84 Regent Street, London, W.1. (211)

Flexible Drive Equipment for descaling tubes and plates. A booklet by the manufacturer gives illustrations and details of a wide range of accessory fittings for flexible shaft equipment. Flexible Drives (Gilmans) Ltd., Smethwick, Staffs. (212)

Rubber-based Adhesives, brochure describing uses and types. The application of adhesives to glass, wood, tile, plastic, etc., is illustrated. British Rubber Development Board, Market Buildings, Mark Lane, London, E.C.1. (213)

Off-peak Thermal Storage Heater for industrial and domestic premises. Folder gives details and input/output ratios and capacities. Thermodare, 79-80 Petty France, London, S.W.1. (214)

Bright Copper Plating. The Cuprobright process, a leaflet describing the system and giving details of solution and deposit. W. Canning and Co. Ltd., Birmingham. 18. (215)

Bright Nickel Solution. Canning; "Gleamax" solution described in a leaflet. Brief details of advantages and savings. W. Canning and Co. Ltd., Birmingham 18. (216)

Synthetic Resin Coating. An 8-page booklet describes the Araldite range of resins which are used as fillers before painting on uneven surfaces. Aero Research Ltd., Duxford, Cambridge. (217)

Paint Repair Unit for infra-red heating method. A leaflet gives details of a portable infra-red unit for use on car and similar repair jobs. General Electric Co. Ltd., Magnet House, Kingsway, London, W.C.2. (218)

Compton Water Spray Gun. Descriptive leaflet on a new type of lever operated, direct mains spray gun for water. Dawson, MacDonald and Dawson Ltd., Compton Works, Ashbourne, Derbyshire. (219)

Compton, Mark 11H spray gun for paints, etc., low pressure, sensitive thumb control, jet sealing cap enables it to be used on intermittent work without drying up. Dawson, MacDonald and Dawson Ltd., Compton Works, Ashbourne, Derbyshire. (220)

Natural Rubber Latex-Cement Compositions in Building. Another of the brochures issued by the British Rubber Development Board, this one deals with the subject of joints for tile and brickwork in industrial and commercial building structures. British Rubber Development Board, Market Buildings, Mark Lane, London, E.C.3. (221)

A WORD OF EXPLANATION

THIS Reader Service Section was started in INDUSTRIAL FINISHING over six months ago. Since then we have sent out literally hundreds of items of manufacturers' literature to interested readers.

It is run in the mutual interest of readers and manufacturers as a personal service to both. No charge is made to a manufacturer for the inclusion of his material, in fact this is invited, and no charge is made to the reader for the service. It is simply and solely for his convenience to save him writing to dozens of different manufacturers for individual items. Should he wish, however, he can write to the manufacturer direct; the address is always given.

There are two things we would ask to enable us to maintain and improve the service. First, please use the card as soon as possible after publication to avoid disappointment at items being out of stock (when a July card is returned in December most of the items have run out) and *please*, put your name on the card. We have one or two "regulars" who always ring about six items and give no clue as to who they are or where they want them sent!

Again, we do not mind how many items you request. We have one bright boy who rings the entire card each month. However, we must whisper it quietly, he is on the staff of a contemporary publication so perhaps we cannot blame him for looking for cheap copy.

Industrial Colour Harmony

(SPECIALLY CONTRIBUTED)

IT is now commonly appreciated that colour harmony and colour grading in industry are capable of giving very real benefits—expressed in terms of increased production rates and decreased accident rate, together with lower maintenance costs, better management-labour relations, and so on. The primary effect of good colour principles allied to good lighting is an all-round improvement in the psychological well-being of the worker whose individual performance is often a major factor in the assessment of production costs.

The application of colour harmony to factories and workshops is a relatively new science, although its roots go back to the early 1800's when some mill owners did, at the beginning of the Industrial Revolution, make attempts to improve the working surroundings of their labourers. They did this on the commonsense basis that better working conditions make better workers—a truism which still holds good as the basic principle in applying modern colour harmony technique; the main difference being that the subject is now analysed and determined on scientific lines.

The fact that the method still remains, basically, as "applied commonsense" has led to the more technical aspects of colour harmony being regarded with suspicion in some quarters. Colour harmony and colour contrast are, however, technical subjects which cannot adequately be dealt with, and therefore, cannot be applied with maximum (beneficial) effect, without study on scientific lines. This particular science has now been developed to the point where it can be dealt with in highly technical terms, largely incomprehensible to the factory owner who may wish only to apply the results in a straightforward, practical manner. Basic facts to meet such requirements can be reduced to plain, every-day language.

Originally, colour was used purely for decorative purposes. Surface coatings as applied to walls, equipment, etc., in the factory or workshop have the primary duty of protection. Drab, dull colours perform the duty of protective coatings as well as brighter colours, and quite possibly at lower cost. Being "uninspired" colours, as it were, deterioration of such a coating is less obvious, or less objectionable than it would be with a brighter colour—hence necessary maintenance can sometimes be overlooked or postponed well beyond a truly economic limit.

This particular point has been demonstrated most dramatically in in many factories where brightly-coloured machines have replaced the traditional "black" or dull finished machines of the same type. The operator takes a greater pride in cleaning and keeping on top of necessary maintenance requirements with the brighter-coloured machine, so that depreciation is considerably less—a generalisation confirmed by facts and figures from various machine shops throughout the past decade.

However, this is but one feature of the over-all problem. Starting with the "traditional" factory layout with its uniformly dull working surroundings (dull in the colour sense rather than in absence of adequate lighting, although that, too, has been a common failing up to recent years), some immediate improvement can be realised by picking out machine controls and danger points in bright, stimulating colours. Associated with a colour-harmonised machine the effect is much better, colour harmony being designed to give the machine a fresh, "new" appearance with a good working background and critical or working areas picked out from the non-critical areas. The next step consists of adjusting the colour tones and reflectance values of the factory walls to harmonise with the machine areas. Finally, the roof area can be lightened up so that

trusses and beams, etc., appear as unobtrusive as possible and the whole factory interior has the effect of cleanliness and tidiness with lighting conditions giving the effect of bright sunshine outside.

Lighting itself is a subject of considerable importance since eye-strain promotes fatigue, leading to loss of working efficiency, accidents (which may appear due to carelessness), and so on. Light values, as such, are outside the scope of this present article, but the quality of lighting has a direct bearing on the colours chosen for particular purposes. The main essential in working areas is to eliminate as much reflection as possible and employ the right focal colours to obtain the required degree of contrast.

Strictly speaking, "focal" colours are the intense primaries or "warm" colours, such as red, orange, yellows, etc., which appear to stand out from their background and thus draw attention to themselves. They are used chiefly to mark danger points or controls or safety devices which must be instantly visible in case of emergency. The non-critical or static colours are those which appear unobtrusive or restful, such as pastel shades and light greys, blues and greens. They provide an excellent contrasting background to the focal or critical colours.

Less stimulating focal colours may be used on the working or "focal" areas on machines, to provide maximum contrast between the workpiece and the machine background. In this respect buff colours are quite widely used, such as "static" stone, and also pale greens. These, in fact, are not true "focal" colours as originally defined since they are essentially "static."

Certain colours have become accepted through the ages as having a definite (implied) meaning. Red, for example, is the colour associated with danger—a warning colour which stimulates and excites the brain. What is not so commonly realised, however, is that red is not such a good colour as regards visibility. In poor lighting it may tend to appear black. Its use, therefore, is somewhat limited in modern industrial colour schemes—mainly to fire-fighting equipment and sprinkler pipes, etc. Yellow, another stimulating colour, is far more luminous and thus far more compelling in drawing attention to itself, retaining high visibility at long distances, even under poor lighting conditions. As such, therefore, it is a good colour for marking hazardous areas, such as steps, pit edges, overhead equipment and obstructions, etc. It should, however, be used sparingly otherwise the multiplicity of "hazard" points may become confusing.

Orange has slightly less visibility than yellow, but has greater attention value due to the presence of red. It is, therefore, an excellent colour for marking danger points on machinery, such as cutting edges, exposed gears, pulleys, switch boxes, and so on. Alternative colours for machine controls, danger points, etc., are "focal" yellow, buff or red. Again they must be used sparingly to achieve maximum warning effect.

Green is traditionally associated as the opposite of red—a restful colour signifying safety. Psychologically, it gives rapid recovery to eyes overstimulated by red. Intense green is normally employed for identifying first-aid equipment. Softer shades find widespread application for machine body colours, machine working areas, roofs and girders, ceilings, walls, etc.

Walls and ceilings should, ideally, be good sources of reflected light, calling for the lightest colours, but restful and avoiding glare. Essentially they should minimise the complementary image effect experienced after viewing a "strong" colour for some appreciable time and then glancing away at the background. Colour schemes may also be adapted to "amend" the physical proportions of the room—the ceiling height of a very tall room, for example, appearing appreciably less if the walls are painted in horizontal bands of the same basic colour but with tones getting progressively lighter with increasing height.

End walls of long, narrow rooms painted in a warm colour contrasting with the side walls tends to lend breadth. In machine shops, in particular, walls are sometimes painted in lighter shades of the same general colour scheme as the machines with good effect. Equipment or fixtures permanently attached to the walls, unless unduly large, are best toned in with the general wall colour scheme—

TABLE I. BASIC COLOUR EFFECTS (FULL COLOURS).

Colour	*Influence*	*Applications*
Red	Stimulates and excites.	Marking fire fighting equipment, fire protection, etc.
Orange	Alerts	Marking danger points on machines, etc.
Yellow	Stimulates	Marking objects, obstructions, etc., for maximum visibility.
Green	Counteracts stimulation	Identifying first-aid equipment, showing positions of first-aid rooms, appliances, etc., and rest rooms.
Brown	Warm, restful.	Little used. Depressing if used in large areas.
Purple	Soothing, restful	Little used. Marking extra valuable equipment.
Black	Depressing in large areas.	Used mainly to tone strong colours.
White	Cold, clean	Traffic lines. Orderliness (e.g., background to waste bins).
Blue	Cool, caution	Caution and precautionary markings.

TABLE II. TYPICAL APPLICATIONS OF COLOURS.

Use	*Colour*	*Remarks*
Machines (body)	Static green Static blue Static grey	Main body of machine
	Light stone Light green	For suitable contrast on focal areas
Machine (controls, etc.)	Red Orange Yellow	Restricted Danger points "Warning" points
Walls	Cream Light stone Pale green, etc.	Pastel shades
Ceilings	Cream Light stone Pale greens, etc.	Pastel shades
Roofs and girders	Light blue Light green	Relieves heaviness of roof
	Yellow	Marking overhead mobile equipment, etc.

TABLE III. VISIBILITY BY CONTRAST.

*Order of Visibility**	*Colour (Lettering)*	*Colour (Background)*
1	Yellow	Black
2	Black	Yellow
3	Black	Orange
4	White	Black
5	White	Blue
6	Orange	Black
7	Black	White
8	White	Red
9	Red	Yellow
10	Green	White

* Order of visibility must be considered arbitrary since preference of selection is dependent on individual reaction to the various colour combinations considered. The order given represents a fair "over-all average."

monotones preferred for average-size shops. The over-all effect must be pleasing and restful, with no particular contrasts in the background. The practice of picking out window frames in a darker colour is generally to be avoided, whilst the use of a critical colour for decorative purposes only is definitely harmful to the over-all effect.

Roofs and roof trusses are another feature which should receive equal attention. A dark or sombre roof area is invariably depressing. Machine shop ceilings, in particular, are seldom good sources of reflected light and so a static "cool" colour is generally best, such as a light blue or light green. Overhead crane girders, chains, hoists, crane hooks, etc., are best picked out in the critical yellow, signifying that attention to their whereabouts is required. At the same time, this colour, being light, relieves overhead structures of this nature from appearing "heavy" or bulky.

At the present time there is no over-all standardisation of the use of specific colours for specific purposes.

SYMBOL	GREAT BRITAIN		UNITED STATES	
	COLOUR	MEANING	COLOUR	MEANING
	RED	DANGER	RED	FIRE EQUIPMENT
	GREEN	SAFETY	BLUE	CAUTION
	YELLOW	OBSERVE		
			ORANGE	ALERT
	ORANGE	ALERT		
	BLUE	CAUTION		
			GREEN	SAFETY
			YELLOW	VISI-BILITY

Right: Comparison of the uses and symbols for colours in this country and the U.S.A.

Thus, although most modern colour-harmony schemes follow the same general trends, some differences may exist from factory to factory in the significance of a particular colour. Orange, for example, is the generally recommended "caution" colour for cutting edges, etc., but on some layouts a blue may be used for the same purpose. Strictly speaking, variations of this nature from factory to factory do not matter a great deal, provided the scheme adopted is consistent throughout any one factory. Ideally, too, the critical colours should be used as sparingly as possible so that their actual effect is that much greater. Static colours are not critical in this respect and from a wide range of colours which satisfy the basic requirements, the personal preference of the responsible authority will undoubtedly decide the final choice.

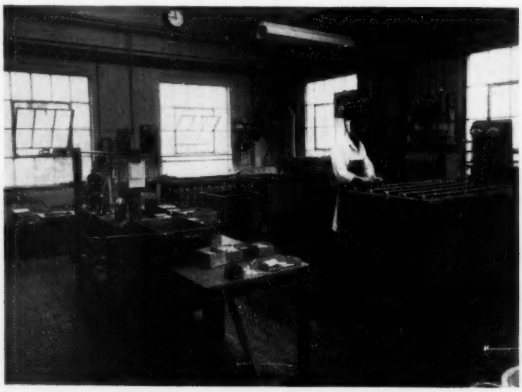
A point of particular significance which must, however, be considered along with industrial colour schemes is that defective colour vision may be quite prevalent amongst the operators. Various surveys based on practical studies of colour blindness are in reasonable agreement that about 20 per cent. of the male and 25 per cent. of the female population of this country have poor or below average colour vision. The form of defective vision may vary, most common being inability to distinguish between red and green except as two different shades of "grey."

Where colour codings or colour markings assume particular significance in a large factory or workshop, therefore, it is becoming common to find symbols associated with each colour. Unfortunately, the system of symbols in current use in this country and America differ for every colour but red (see Fig. 1), and also the specific employment of the various "signal" colours is at some variance. The question of satisfactory, and universally acceptable standards, however, is one which is receiving due consideration at the present time.

FINISHING SHOPS FOR INSTRUMENT FACTORY

ABOUT eight weeks ago the Sigma Instrument Co. Ltd., opened a new extension to their works at Letchworth. The opening of that extension marked the latest stage in the development of the company. Founded in Stratford-on-Avon in 1920, by Dr. J. A. Stewart, the works moved to Letchworth in 1923 and continual expansion led to the present site being secured in 1928. For the next ten years Dr. Stewart continued to manufacture a range of high-grade instruments. A private limited company was then formed and shortly afterwards the present managing director, Mr. John Loxton, was appointed.

Mr. Loxton, who had been a teacher in production engineering at Northampton Polytechnic, then proceeded to develop from the original Sigma instruments a wide range of measuring equipment based upon the linkage employed



Right: A view of the paint spraying and stoving shop. Facing page shows a view of the plating department

in those instruments.

In 1948 Alfred Herbert Ltd., Coventry, were appointed selling agents in the British Isles and in 1952 acquired a controlling interest in the company.

In 1939 when the country was desperate for measuring instruments—it had relied on Germany and no development work had been done. Sigma and other companies set themselves the task of filling the gap in unit measuring capacity. Mr. Loxton started on pitch and diameter measuring gauges and then went on to comparator gauges. He used the mechanism in the recording calorimeter to amplify the movement of the plunger in the gauge comparator. From basic instruments Sigma developed the name for first-class work and attracted people with problems of measurement.

As the precision instrument is in daily use in the inspection shops and workshops of industry, it follows that it must have a good protective and attractive finish and, in this respect, the Sigma company are right up-to-date. The new extensions include modern and well-equipped plating and painting shops and these are provided with all the plant and equipment necessary to enable them to handle the range of work involved in instrument manufacture.

Our photographs show sections of the plating and painting shops and work can be seen in progress in the spray booths and plating vats.

NATIONAL INDUSTRIAL FUEL EFFICIENCY SERVICE

THE above is the name of the new company emerging from the Pilkington Committee to provide advice to industry and non-industrial establishments—not domestic users—to give practical help in economic fuel usage. The chairman is Sir Leslie Hollinghurst and the directors appointed are:

Sir Patrick J. Dollan, chairman, Scottish Fuel Efficiency Advisory Committee.

Sir John Hacking, deputy chairman (operations), British Electricity Authority.

Sir Edward Herbert, deputy chairman and managing director, William Hollins and Co. Ltd., Nottingham.

Mr. Leslie A. W. Jenkins, joint managing director, John Wright and Sons (Veneers) Ltd., London.

Mr. Henry F. H. Jones, deputy chairman, the Gas Council.

Mr. E. Julian Pode, J.P., managing director, the Steel Company of Wales, Ltd.

Mr. Jack Tanner, chairman of the T.U.C. General Council and a member of the British Productivity Council.

The company will be financed from the National Coal Board, the British Electricity Authority and the Gas Council, with possible contributions voluntarily from industry.

FINISHING TITANIUM

by

THOMAS A. DICKINSON

ALTHOUGH many problems remain to be solved, evidence to date provided by the aircraft industry in America clearly indicates that titanium can be finished as satisfactorily in most respects as more conventional materials.

Titanium is a metallic element of particular importance to the aircraft industry at the present time because it is almost as light as aluminium, yet comparable to stainless steel in terms of mechanical strength. Moreover, it seems destined to become a material with many applications in virtually all industries because:

(a) It is the fourth most abundant structural metal in the crust of the earth.

(b) For the first time since it was identified as a chemical element more than fifty years ago, titanium is now being extracted from ore at commercially-feasible prices.

Vacuum processing plant of the type shown here is used in the evaporation coating of titanium

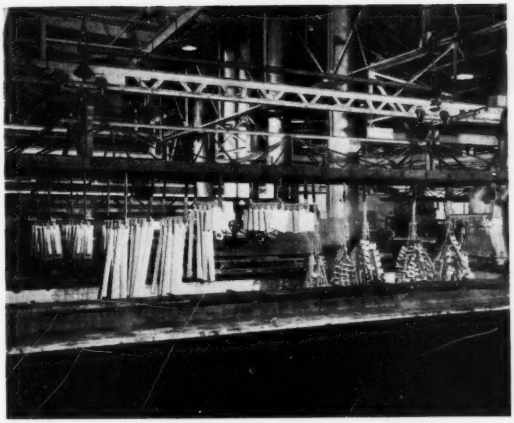
Finishing techniques are highly essential to the successful use of titanium because the latter has an unusual tendency to oxidise. On the other hand, it is the tendency of titanium to oxidise that makes the subsequent finishing operations difficult in most respects.

For example, most efforts to electroplate titanium are believed to have been unsuccessful because it is difficult to get the metal into a plating bath with the oxide-free surfaces that are essential to the adhesion of a plated deposit. However, titanium stock materials are now being copper-plated satisfactorily enough to reduce galling as they are fabricated; and laboratory tests have shown that titanium parts can be adequately plated with other metals, if they are cleaned with sufficient care.

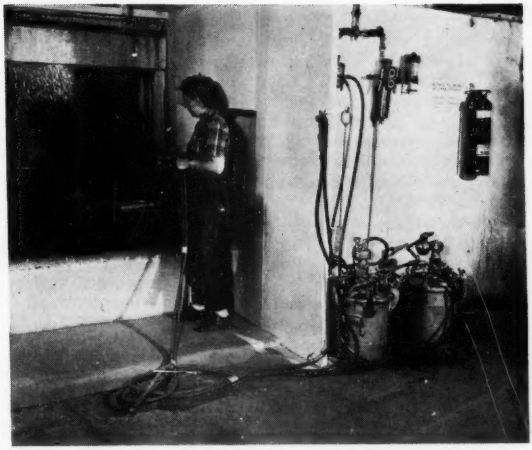
Both chemical and mechanical methods have been used in cleaning titanium. Mechanical techniques are, of course, preferable where heavy deposits of scale must be removed; but, since this normally involves the use of grit- or vapour-blasting equipment, the use of chemical cleaners is usually specified if maximum surface smoothness must be maintained.

Foreign matter such as dirt, oil, and grease can be removed from titanium surfaces in a conventional manner with common commercial solvents or detergents. However, the complete removal of oxides necessitates the use of special acid or caustic solutions.

One of the best methods of removing heavy scale formations at the present time involves the immersion of titanium parts in a Virgo or caustic bath, heated to about 800° F. This is usually followed by a water quench and a quick dip in a brightening solution composed of 2 per cent. hydrofluoric acid and 10 per cent. nitric acid by volume. The brightening solution



Titanium components can be anodised much the same as aluminium parts with equipment of the type shown in this photograph



After anodising the treated titanium parts can be finished with ordinary organic materials and methods as in this photograph

alone is generally sufficient for the removal of oxide deposits which cause the metal to be only slightly discoloured.

Some embrittlement can be caused where sodium hydride or caustic soda solutions alone are used to descale thin titanium sheet materials, but this can usually be avoided where a Virgo or similar commercial solution is properly employed.

For many low-temperature applications, titanium materials or parts can be anodised in a chromic or sulphuric acid bath and then dyed or organically finished—much the same as aluminium is processed. However, many of the most practical uses for titanium at present require extreme chemical inertness at elevated temperatures.

Titanium has a very high melting point (3,140° F.). But, unfortunately, it will oxidise with exceptional speed if its surfaces are exposed to ordinary

air at temperatures exceeding 800° F. Therefore, titanium parts for elevated-temperature applications must be protected with metallic or ceramic coatings.

In the latter connection, the commercial significance of electroplating techniques remains to be demonstrated. Similarly, while sprayed-metal coatings can be satisfactorily anchored to titanium parts that have been properly roughened and machined, there is no reason to believe that a pneumatically-applied metal finish can have the purity and low porosity that is necessary to prevent the oxidation of titanium at elevated temperatures.

However, titanium has been satisfactorily metallised with evaporation on vacuum coating equipment. Vacuum coating is the process whereby air is evacuated from a vacuum chamber so as to permit the substitution of an inert gas such as argon or helium and thus to prevent oxidation, as a deposition material is heat-vaporised with electrical current. Heat-vaporisation causes an inert coating material—such as aluminium, gold, or tungsten—to be smoothly deposited on a titanium deposition surface, much the same as steam from hot water may be deposited on a window pane, regardless of whether the finishing material is electrochemically compatible with titanium.

Both metallic and non-metallic coatings can be built up on titanium parts in layers with thicknesses ranging upward from a millionth of an inch, simply by limiting the amount of time during which evaporation takes place in each case. Little or no heat is conveyed to the deposition surfaces because the coating particles are of molecular dimensions and subject to rapid chilling.

Metallic evaporation or vacuum coatings resemble electroplated coatings, although they do not require the buffing or polishing that is necessary to produce maximum brightness in electroplated coatings; and, because of their extremely low porosity, they can be applied in extremely thin layers which will adequately protect titanium without reducing the flexibility of the thinnest sheet stampings.

As yet, vacuum coatings are not being applied as extensively as might be expected because of high costs. Such costs are not great if computed on a day-by-day production basis over a long period of time, but vacuum coating equipment does necessitate an initial investment that tends to discourage many prospective users.

Therefore, many firms have been concentrating on the development of ceramic coatings which can be applied to titanium parts in the same way as porcelain enamels are applied to certain iron and steel products.

LABORATORY MEASUREMENT OF CORROSION IN SOILS

A RECENT study by the National Bureau of Standards in the U.S.A. has shown that reliable data on the corrosion of ferrous metals in soils of various types can be obtained in the laboratory in a period of six months. Usually field tests lasting 10 years or more are required. In the investigation, which was conducted by W. J. Schwerdtfeger of the Bureau's corrosion laboratory, corrosion was produced in small laboratory cells by differential aeration of metal discs in contact with soil within the cells. The results for 15 different soils showed good correlation with the corrosion observed on wrought specimens in long-term exposure tests. The technique used should thus provide a valuable basis for predicting the service of iron and steel structures exposed to various soils.

The corrosion of metals in many soils is attributed chiefly to differences in the accessibility of oxygen to the surface. Differences in oxygen concentration create differences in the potential of various areas, resulting in the flow of electric currents through the soil from the oxygen-deficient areas (anodes) to those areas (cathodes) receiving more oxygen. The laboratory corrosion cells used made use of this principle. Each cell consisted of a cylindrical Lucite enclosure containing two short-circuited disc-shaped electrodes of the same material, iron or steel. One electrode was solid, the other perforated, and they were separated by a layer of moist soil. The edges and one face of each of the two electrodes were covered with bituminous paint. The layer of moist soil in contact with the coated side of the perforated electrode regulated the diffusion of air to the electrodes. The perforated electrode received a greater supply of oxygen than the solid one adjacent to which the soil was puddled,

and therefore assumed a more positive potential.

If the corrosion of ferrous metals in all soils proceeded at a rate that was constant with time, weight-loss measurements made after a short arbitrary period of exposure should indicate relative rates of corrosion, assuming negligible cleaning errors. Actually, however, corrosion in soils may proceed at a rate proportional to time, or may sometimes cease entirely, depending on the type of soil. It was thus necessary to operate the laboratory corrosion cells for a sufficiently long period to produce effects comparable to those shown by field exposure tests.

In the N.B.S. investigations, the corrosion cells were kept on short circuit for six months. During this time periodic measurements of cell current permitted study of the progress of corrosion with time. At the end of the period the combined weight losses of the two electrodes were taken as the measure of corrosion.

To evaluate the laboratory corrosion cell as a means for predicting corrosion in the field, samples of soil collected at 15 exposure sites were used. The results were correlated with weight-loss measurements made on short lengths of steel and wrought iron pipe which had been exposed for 10 years at the same 15 localities. An empirical equation relating the laboratory and field data indicated that the laboratory measurements could be used to predict field weight losses with root-mean-square error of about ± 4 oz./ft.^{2} for corrosion rates ranging from 2·5 to 30 oz./ft.^{2} for the 10-year exposure period. Because the 15 soils covered the range of corrosivity of the soils of the United States, this empirical relationship may be applicable to any soil.

Because some underground structures, such as piping systems and storage tanks, usually fail as a result of pitting, this factor was also considered. Analysis of the field data showed a good correlation between weight losses and maximum pit depths on wrought ferrous specimens which had been exposed for 10 years at 58 exposure sites. These data were then combined with the first empirical equation to obtain a second equation which can be used to predict, with an average error of ± 18 mils, the depth of the deepest pits occurring on wrought iron or steel buried for 10 years. For the prediction of weight losses and maximum pit depths on areas greater than the area of the field specimens and for periods of exposure other than 10 years, use was made of general equations relating weight losses and maximum pit depths with length of exposure and exposed area. Average values for the constants to be used in these equations were obtained.

It was found that the corrosion cell could detect significant differences between the corrosion rates of cast iron and steel, which are generally considered to corrode at about the same rate in soils. Thus, the cell might be used to study the effects of variables, including composition upon the corrosion rates of steels. It is also reasonable to expect that laboratory corrosion cells could be used to predict the corrosion of non-ferrous metals—copper, brasses, lead, zinc and possibly aluminium—in various kinds of soils. Although measurements with the laboratory cell should not be considered as replacing field exposure tests entirely, it is unlikely that materials which corrode at the same rate in the laboratory would corrode at significantly different rates in the field. Hence, the corrosion cell should serve a useful purpose in the selection of materials for field exposure tests.

ON THE NEXT PAGE

THE two following pages have been specially arranged to permit them to be cut out and pasted up to form a fault-finding chart for use in the spray finishing shop.

The faults enumerated are the ones principally met with in the ordinary spray painting systems, it is suggested that the use of this chart can contribute to the production of better finishes.

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"INDUSTRIAL FINISHING" FAULT FINDING CHART for SPRAY PAINTERS

Possible Causes	*Suggested Remedies*
" ORANGE-PEEL "	
1. Paint not thinned down sufficiently.	1. Add the correct amount of solvent by measure.
2. Not depositing a wet coat.	2. Check solvent. Use correct speed and overlap of stroke.
3. Gun traversed too rapidly ("dusting" the paint).	3. Avoid "whipping." Take deliberate, slow strokes.
4. Air pressure too low.	4. Increase air pressure or reduce fluid pressure.
5. Gun traversed too far from the surface.	5. Traverse the gun 6 to 10 inches from surface
6. Overspray striking a previously sprayed surface.	6. Spray detail parts first. End with a wet coat.
EXCESSIVE SPRAY FOG	
1. Air pressure too high.	1. Use lowest amount of compressed air necessary.
2. Spraying past surface of the product.	2. Release trigger when gun passes work.
3. Gun traversed too far from the surface.	3. Traverse the gun 6 to 10 inches from surface.
4. Material thinned down too much.	4. Add the correct amount of solvent by measure.

SAGS

1. Dirty atomiser head and fluid tip (distorted spray pattern).	1. Remove atomiser head and clean tip and atomiser head carefully.
2. Gun traversed too close to the surface.	2. Traverse the gun 6 to 10 inches from surface.
3. Trigger not released at end of stroke (when stroke does not go beyond work).	3. Operator should release the trigger after every stroke.
4. Gun traversed at wrong angle to surface.	4. Gun should be traversed at right angles to surface.
5. Paint piled on to thickly.	5. Learn to calculate depth of wet film of paint.
6. Paint thinned down too much.	6. Add the correct amount of solvent by measure.

STREAKS

1. Dirty atomiser head and fluid tip (distorted spray pattern).	1. Remove atomiser head and clean tip and atomiser head carefully
2. Insufficient or incorrect overlapping of strokes.	2. Follow the previous stroke accurately.
3. Gun traversed too rapidly ("dusting" of the paint).	3. Avoid "whipping." Take deliberate slow stroke.
4. Gun traversed at wrong angle to surface.	4. Gun should be traversed at right angles to surface.
5. Holding gun too far from surface.	5. Maintain from 6 to 10 inches from surface.
6. Air pressure too high.	6. Use lowest air pressure necessary.
7. Split spray.	7. Reduce fan adjustment.

Synthetic Paint Stoving on Dental Equipment

A LARGE manufacturer of dental equipment in the South of England required to improve the finish and use synthetic stoving mediums instead of cellulose on their equipment. In addition, they wished to be able to finish a variety of components of all sizes, shapes and weights in a range of different colours.

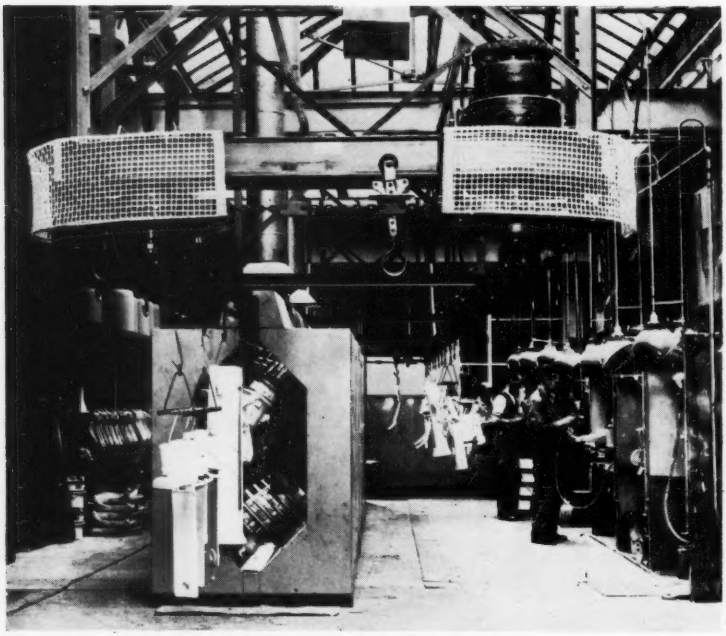
As a result of successful pilot equipment tests, a gas-heated infra-red oven was installed, through which the work passed on a travelling overhead monorail conveyor, the speed of which is automatically controlled. After each coat of enamel the article is hung on the conveyor and passed through the tunnel. The parts range from light sheet metal components weighing $\frac{1}{2}$ oz. to castings weighing 150 lb., and these are finished in a wide variety of colours from black to white. Both the conveyor and the tunnel were manufactured and installed by Stewart Gill and Co. Ltd., Silverdale Road, Hayes, Middlesex.

Fig. 1 is a general view of the plant showing the location of the spray booths alongside the conveyor affording minimum of operation effort.

Description

One No. 5/8/3018 "Rapiradia" gas-

Fig. 1. General view of the paint drying plant



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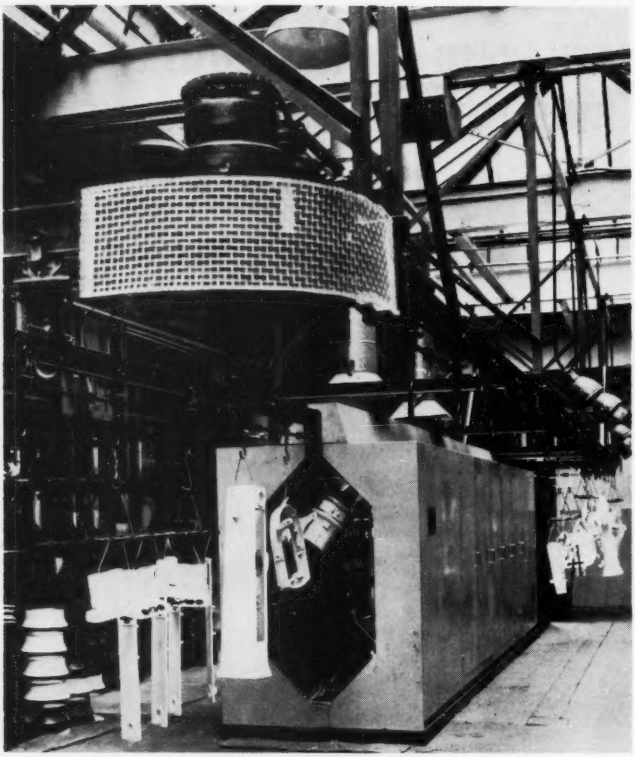

Fig. 2. Oven and conveyor showing work emerging from the drying section

heated radiant heat tunnel was installed, measuring over-all, 22 ft. 6 in. long × 4 ft. 6 in. wide × 7 ft. 6 in. high and fitted with entry and exit vestibules, each 5 ft. long. The radiant zone measures 12 ft. 6 in. long × 2 ft. 6 in. wide × 5 ft. 4in. high and the heating equipment consists of forty 3018. V. gas-heated black emitter panels. A ventilation canopy is an integral component of the unit and affords proper ventilation of the products of combustion and solvent vapours. The gas consumption is approximately 5 therms per hour at a pressure of 1·5 in. w.g. and the control equipment includes constant pressure governors, Arkon gauges and Thermoperl flame failure equipment.

A light overhead rail conveyor with a total track length of 80 ft. arranged rectangularly 35 ft. × 5 ft. is employed with a speed range of 9 in. to 3 ft. per min. The speed is infinitely variable but is normally 1 ft. 3 in. per min. Trolleys and work carriers are spaced at 10-in. intervals.

Fig. 2 shows a clear view of the oven and the conveyor.

This installation is a good example of the ability of radiant heating to deal with a variety of shapes, weights and sizes of articles, provided care is taken to avoid screening of one component by another.

Reproduced from Report No. 543/53 of the Industrial Gas Development Committee of the Gas Council. Information supplied by the South-Eastern Gas Board.

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Heating of Acid Pickling Liquor by Submerged Combustion

THE information in this report was provided by the Eastern Gas Board, Tottenham Division, as a result of tests carried out at the works of Messrs. Symonds and Sons Ltd., Valour Wire Works, Great Cambridge Road, Enfield, Middlesex.

The heating of acid pickling liquor facilitates the removal of the oxide film from coils of thick copper wire (so called "rods") before being drawn into the finer sizes.

The former method of heating was by the direct injection of steam produced in a hand stoked coke-fired boiler. The submerged combustion equipment which has displaced the boiler was sold through the Tottenham Undertaking and installed by the makers, Messrs. Nordac Ltd., Cowley Mill Road, Uxbridge, Middlesex.

Description of Plant

The two acid vats, which are lined with acid resisting tiles, are each 20 ft. by 4 ft. by 4 ft. sunk below ground level, and have a 4 in. diameter interconnecting glazed earthenware pipe just below the level of the acid, the depth of which is 3 ft. 6 in. The total capacity of the vats is 3,500 gal. and the required acid temperature is 100° F.

The burner is fed with a complete gas-air mixture from a Rootes type compressor of 1,500 c. ft./hr. capacity. Town gas filtered and governed to 3 in. w.g. is passed through an orifice plate to the compressor. Filtered air is drawn from the workshop and passed through an orifice plate, meeting the gas supply at the inlet to the compressor. The gas-air ratio is adjusted with the aid of the water gauges (graduated in c. ft./hr.) which are connected across the orifice plates. Under normal working conditions the gas-air mixture pressure is 4 lb. per sq. in. measured at a point between the compressor outlet and the adjacent Holmes-Kemp flame trap. Fig. 1 shows a corner of the tank containing the burner.

The Swindin submerged burner consists of a combustion chamber of stainless steel tube with a refractory

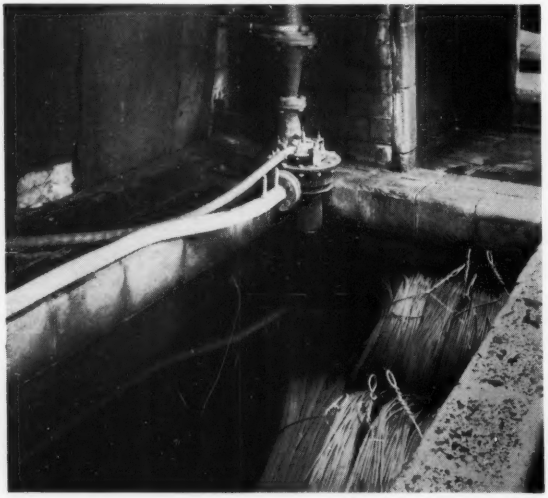

Fig. 1. A corner of the acid vat containing the submerged burner

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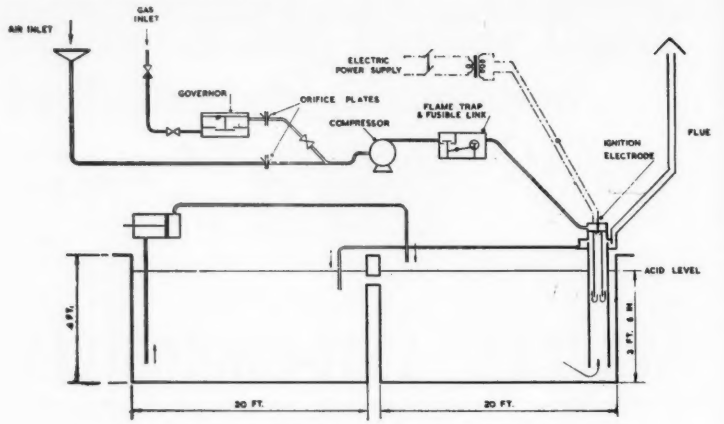

Fig. 2. Arrangement of the submerged burner in the pickling vats

lining. At the top of the burner tube is a mixing head which incorporates the gas-air feed, an ignition electrode and a perspex inspection window. Surrounding this tube is a mild steel tube, protected with a coating of "Vulcoferran" acid resistant rubber which reaches down to the vat bottom.

The products of combustion issue from the burner and bubble upwards through the annulus formed by the two tubes lifting liquor with them. From the burner head the products are ventilated to atmosphere via a flue pipe and the liquor lifted gravitates through a lead pipe to the further vat. To obtain the same temperature in each vat the liquor is circulated by a motor driven pump.

No thermostatic control is incorporated in the equipment, and the consumer has found it convenient to operate the burner at maximum gas rate for 9 to 10 hours continuously each working day and shut down completely for the rest of the day.

Fig. 2 shows the arrangement of the submerged combustion burner.

Results of the Test

The complete process of acid pickling

Period of test: One full working week of 5½ days (Approx. 10 hours per day).

Weight of copper pickled: 840 "Rods" at 2¼ cwt. each = 90 tons 9 cwt.

Average gas rate during 54 hours operation = 190 c. ft./hr.

Gas consumed = 10,200 c. ft. (48·2 therms).

∴ 1 ton 17 cwt. copper pickled per therm of gas.

Test on burner

Gas rate = 210 c. ft. per hr. (0·99 therms per hr.)

Gross calorific value of gas = 472 B.Th.U./c. ft.

Temperature of acid passing through the burner. Inlet = 78° F. Outlet = 118° F.

Increase in temperature = 40°

Rate of acid flow = 3·6 gal./min.

Thermal efficiency of burner unit (based on gross C.V. of town gas) =87 per cent.

Dilution

Analysis of the pickling liquor passing through the burner indicated that the strength of the sulphuric acid was reduced from 4·72 per cent. to 4·68 per cent. A throughput of 180 gal. per hour for 54 hours a week resulted in a dilution of:—

$$180 \times 100 \times 54 \text{ gal.} = 80{\cdot}7 \text{ gal.}$$
$$0{\cdot}83$$

On a working capacity of 3,500 gal., this would reduce the acid strength from 4·72 per cent. to 4·61 per cent. In actual practice, the acid strength was reduced from 4·72 per cent. to

(*Please turn to page* 372.)

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NAMES IN THE NEWS

Appointments

Mr. George H. Turner has recently been elected to a seat on the Board of R. Cruickshank and Co. Ltd. He joined the company nearly twenty-five years ago and has been closely connected with all the activities of the firm.

Mr. R. W. Allen, B.Sc.(Eng.), A.M.I.E.E., has just been appointed North-East area representative for Nife Batteries, Redditch, in succession to **Mr. S. K. Hodgkinson.** Mr. Allen is living on Tyneside and will cover Durham, Cumberland, Westmorland and parts of Yorkshire.

Mr. C. F. Merriam, chairman of the British Xylonite Company, has been elected the first president of the British Plastics Federation, which was founded in 1933.

Mr. G. W. Robertson, for many years sales manager of Solignum Ltd., has been appointed a director of the company.

Mr. Roy Winter has joined his father, **Mr. Sydney Winter,** as a director of the Trico Plating Co. Ltd., of Walworth, London, S.E.17. **Mr. Jack Hale** has recently become the firm's representative in the London area, and **Mr. L. Baldock,** former manager of the anodising department, has left the company.

Mr. L. H. Cooper, chairman of the Mond Nickel Co. Ltd., has been elected a vice-president of the parent company, the International Nickel Co. of Canada Ltd. **Dr. John F. Thompson,** chairman of Inco, announced that Mr. Cooper will assume the new office on 1st January, 1954.

Obituary

We regret to announce the death of the following:

Mr. Arthur Henry Newton, late director of Windsor and Newton Ltd., who died recently aged ninety years.

Mr. William Raymond Simeons, managing director of The British Gelatine Works Ltd., died on 28th October, 1953.

Lt.-Col. W. A. Vignoles, D.S.O., M.I.E.E., a director of Evershed & Vignoles Ltd., died at his home on Saturday, 24th October, 1953.

Retirements

Dr. W. G. Reid, manager of the I.C.I. (Dyestuffs) Ltd. works at Grangemouth, recently presented **Mr. T. I. Davies,** a chemist on the staff of this branch of I.C.I. Ltd., with a television set to mark his retirement. Mr. Davies did much of the pioneer work on dyestuffs at Grangemouth.

Mrs. George Parsons recently made presentations on retirement to **Mr. H. W. Pantlin,** chief cashier; **Mr. L. Goodchild,** sales manager; and **Mr. K. W. Shipcott,** chief clerk. The combined service of this trio exceeded 137 years!

Institute of General Managers.—Over 100 chief executives attended the inaugural dinner of the Institute of General Managers, at the Savoy Hotel, London, on Friday, 20th November, 1953. Guests of honour included Sir Rupert De la Bere, Bt., K.C.V.O., M.P., and Sir Patrick Hannon. A number of managing directors and general managers have recently formed the Institute of General Managers. Productivity team after productivity team has emphasised the vital part played by top management in American industry. In this country the need for a powerful and representative professional institute of chief executives has become increasingly apparent. The drive for greater productivity and management effectiveness in industry has added emphasis to this need. Those interested should apply for further information to the Registrar, Institute of General Managers, 86 Eccleston Square, London, S.W.1.

Commercial and Industrial Information Service.—Congratulations to L. M. Harrod, Chief Librarian and Curator of the Islington Central Library, 68 Holloway Road, London, N.7, for a useful booklet describing the reference services at the Islington Library. This is kept up to date daily and includes a large list of trade and technical periodicals including all the Arrow Press publications.

The Research Association of British Rubber Manufacturers, formerly at 105 Landsdowne Road, Croydon, Surrey, has now moved to Shawbury, Shrewsbury, Shropshire.

FELLOWSHIP IN METALLURGY

THE United Steel Companies Ltd. announce that they have established a Research Fellowship in Metallurgy in the University of Sheffield and this will be tenable in the Department of Metallurgy.

The object of the fellowship will be to advance metallurgical knowledge and not to train men for research. The persons to be appointed from time to time will therefore be those who have already served their apprenticeship in research and have shown ability to conduct independent investigations. The field of study within which they will be expected to work will be ferrous metallurgy, but this does not exclude the appointment of researchers in refractory matters, knowledge of which is of great importance in ferrous metallurgy.

The Autumn issue of *Chez Nous*, the popular house organ of the Pinchin Johnson and Associates Group, has just been published and contains photographs of the Coronation Day celebrations in the City and in Torquay at the Torbay Paints Co., Brixham. In addition an interesting selection of personality notes and photographs is included giving news of the movements of many of the personalities within the various firms comprising the group.

A leaflet, recently received from Canning and Co. Ltd., of Birmingham, describes their insulated cathode suspenders for both manual and automatic plating plant. It also gives details of the insulation service for users who construct their own jigs for special purposes.

AN INVITATION

To individual readers: The Personal Reader Service Section facing page 348 is for your use and convenience, do you make use of it?

To firms interested in finishing shop supplies: You are invited to send in material suitable for inclusion in the above feature, there is no charge for this service and it is operated in our mutual interest.

Elcontrol Ltd.—During the past twelve months Elcontrol Ltd., 10 Wyndham Place, London, W.1, have introduced a number of new industrial control equipments and modified and improved a number of existing items. Details of these are available from the company as follows: F.S.M. Furnace Safeguard Equipment (*Data Sheets F.S.M. and F.S.5M.*); FS.7 Furnace Safeguard Equipment. (*Data Sheet F.S.*7); Photoelectric Registration Controller. (*Data Sheet P.R.C.*); High Speed Photoelectric Counter. (*Data Sheet F.S.C.*); Current Overload Relays. (*Data Sheet O.R.*); Proximity Switch. (*Data Sheet* 9); Liquid Level Control Equipment. (*Data Sheets* 11 (*Control Units*) and 12 (*Probe Fittings*)); Twilight Switch. (*Data Sheet P.S.L.*).

A set of three brochures dealing with rubber in paints, in adhesives and in latex compositions for the builder has been issued by the British Rubber Development Board. Copies are available on request from the Board at Market Buildings, Mark Lane, London, E.C.3.

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(*Continued from page* 368.)

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The following are typical references to the subject:—

Hammond, C. F., "The History and Development of Submerged Combustion," *J. Inst. F.*, 1930, **3**, p. 303.

Swindin, N., "The treatment of spent pickle liquor," *Trans. Inst. Chem. E.*, 1944, **22**, p. 56.

Swindin, N., "Recent Developments in Submerged Combustion," *Trans. Inst. Chem. E.*, 1949, **27**, p. 209.

Reproduced from Report No. 536/53 of the Industrial Gas Development Committee of the Gas Council. Information supplied by the Eastern Gas Board.

CATHODIC PROTECTION OF PIPELINES AND STORAGE TANKS

THIS book by V. A. Pritula, translated from the Russian and published by D.S.I.R., is available at Her Majesty's Stationery Office, price 10s., 6d. postage, or 2 dollars 25 cents U.S.A.

There is no doubt that the successful application of cathodic protection both in America and in Russia largely in connection with the gas and petroleum industries has pointed out how the vast expenditure on maintaining pipelines can be reduced. In Britain there is an estimate of £5 million each year due to corrosion of underground water pipelines.

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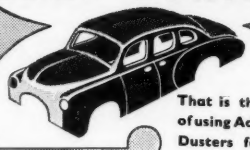
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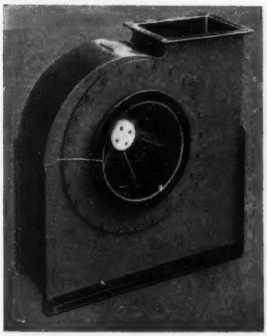

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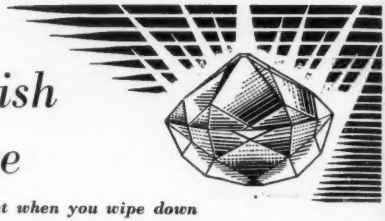

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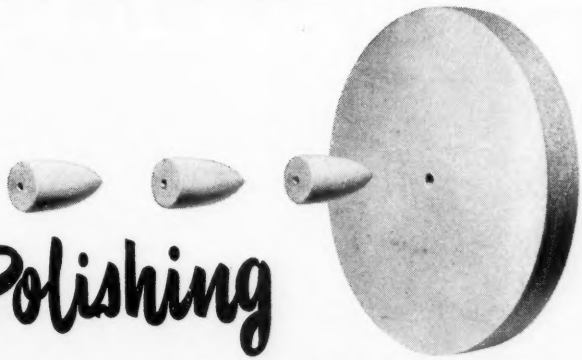

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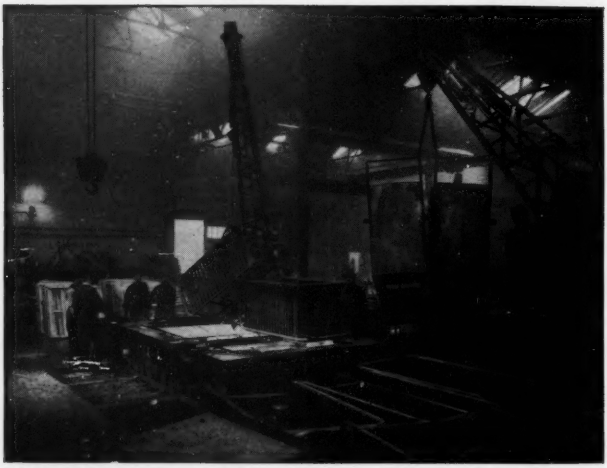

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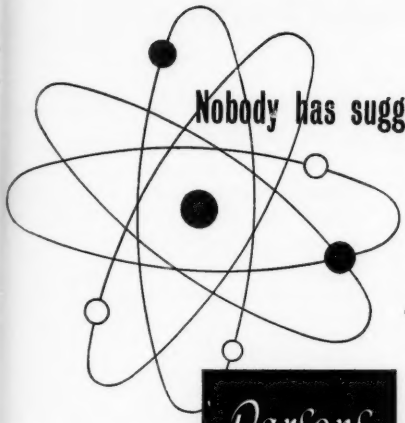

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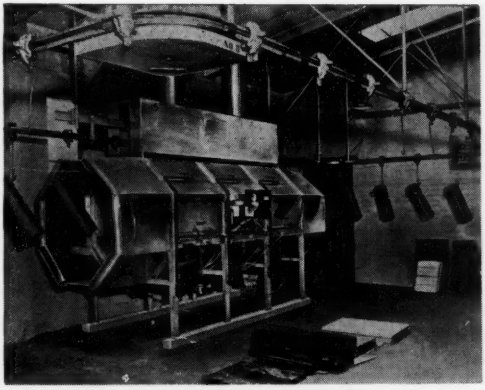

A tunnel of Bratt Colbran Radiant Units stoving finishes on food canisters. (By courtesy of Messrs. Grundy (Teddington) Limited.)

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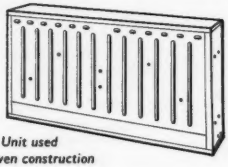

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